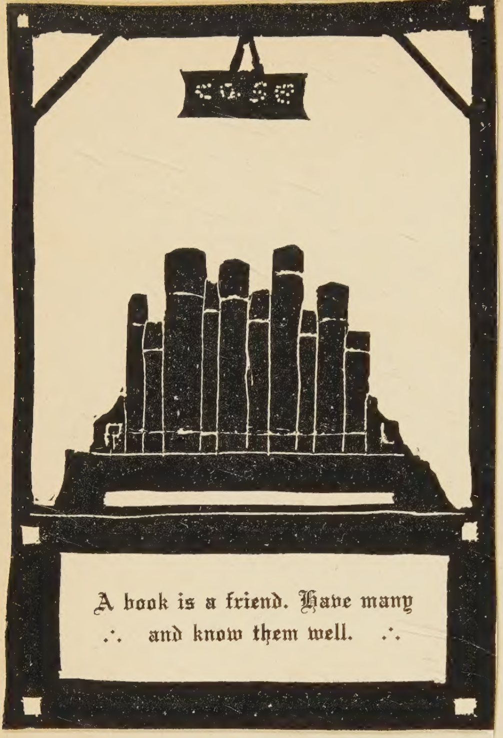

A book is a friend. Have many
∴ and know them well. ∴

MODERN METHODS OF TREATMENT

# MODERN METHODS OF TREATMENT

BY

LOGAN CLENDENING, M.D.

PROFESSOR OF CLINICAL MEDICINE, LECTURER ON THERAPEUTICS, MEDICAL DEPARTMENT OF THE UNIVERSITY OF KANSAS; ATTENDING PHYSICIAN, KANSAS CITY GENERAL HOSPITAL; PHYSICIAN TO ST. LUKE'S HOSPITAL, KANSAS CITY, MISSOURI

WITH CHAPTERS ON SPECIAL SUBJECTS

BY

H. C. ANDERSSON, M.D.; J. B. COWHERD, M.D.; H. P. KUHN, M.D.; CARL O. RICKTER, M.G.; F. C. NEFF, M.D.; E. H. SKINNER, M.D.; AND E. R. DEWEESE, M.D.

*THIRD EDITION*

ST. LOUIS

THE C. V. MOSBY COMPANY

1929

Printed in U. S. A.

Press of
THE C. V. MOSBY COMPANY
St. Louis

TO

MY FRIEND

D. H. C.

## PREFACE TO THIRD EDITION

This book was planned to furnish an outline of all the methods of treatment used in internal medicine.

In my experience as a teacher of the subject I could find no textbook that gave a well-balanced account of diet as well as drugs, of hydrotherapy as well as diet, of blood transfusion as well as hydrotherapy, all in one volume. The student if he were to learn of all of these things must have separate books on dietetics, hydrotherapy, psychotherapy, etc. In this book every department of medical therapeutics is covered.

My aim has been to describe each method of procedure so clearly and minutely that a person who has never seen it performed could do it from the description.

The first part of the book describes the procedure, the second part gives the indications for its application, based upon the principles of physiological pathology.

At the end of each chapter I have placed a short list of references. These largely refer to articles written in English and to publications easily available. This has been done deliberately, as it has been my experience that if we are to encourage students to read more widely we must not make it too difficult. Practitioners using the book may not have a large library of foreign reference works available.

This edition—the third—has been carefully revised. I have not endeavored to add every suggested change in therapy that has developed since the last edition. My inclusions have been conditioned both by the limitations of my experience and by my judgment as to what methods are firmly established and buttressed by scientific evidence. The account of diathermy has been rewritten. Synthaline, myrtillin, euphyllin, sulphocyanate, barium chloride, and erysipelas antitoxin have received brief mention. The articles on quinidine sulphate, liver in anemia and iodine in goiter have been revised. The account of nonspecific protein therapy has been amplified, particularly as to its application to peripheral vascular disease. Several mistakes which, as Horace Walpole said, indicated that it was the work of a gentleman rather than of a mere scholar, have been corrected.

The general plan and purpose of the book have not been changed. I have been led to believe, from many generous letters I have received, that this plan has been found useful to actual practitioners of medicine. In every case I have tried to keep in mind the problems of the general practitioner and to encourage him to use methods and to adopt methods which

he is likely to believe are effective only in the hands of what the world has unfortunately come to call specialists.

I am indebted to my collaborators for special chapters in fields in which I would be very little at home, and to my assistant, Miss Catherine Fowler, to my secretary, Miss Emily Green, to Doctor P. T. Bohan, Doctor Ralph H. Major and Doctor C. C. Dennie for much help, criticism and advice. To Doctor R. L. Sutton I am indebted in a very special way for the initial encouragement to the task.

Logan Clendening.

Kansas City, Mo.

# CONTENTS

## PART I

## GENERAL THERAPEUTICS—THE METHODS USED IN TREATMENT

### CHAPTER I



### CHAPTER II



### CHAPTER III



### CHAPTER IV

## CHAPTER X



## CHAPTER XI



## CHAPTER XII



## CHAPTER XIII



# PART II

# SPECIAL THERAPEUTICS—THE APPLICATION OF THERAPEUTICS TO PARTICULAR DISEASES

## CHAPTER XIV

## CHAPTER XV



## CHAPTER XVI



## CHAPTER XVII



## CHAPTER XVIII

CHAPTER XIX



CHAPTER XX



CHAPTER XXI



CHAPTER XXII

## CHAPTER XXIII



## CHAPTER XXIV



## CHAPTER XXV

# LIST OF ILLUSTRATIONS

# MODERN METHODS OF TREATMENT

## PART I

## GENERAL THERAPEUTICS

## THE METHODS USED IN TREATMENT

### CHAPTER I

### REST

Rest and surgery are the most effective therapeutic methods the modern physician has to offer a patient. Surgery does the ideal thing—it separates the patient from his disease. It puts the patient back to bed and the disease in a bottle. Other methods of treatment are largely designed to aid the body in an attempt to return to normal conditions, by Nature's means of restoration. In doing this no method is so effective as rest.

Rest is the best therapeutic measure the physician (as distinguished from the surgeon) has in his armamentarium. No book on therapeutics can afford to go on to other methods without first putting down rest.

**Rest in Bed.**—Let me quote the wise words of Frank Sherman Meara:

"Rest means a comfortable bed, well made and well cared for; it means a competent nurse to exercise every nicety of her profession; it means mental quiet, the exclusion from the sick room of unnecessary visitors, of friends and even members of the family except for such brief moments as will afford comfort to the patient."

Words that should be carved upon your hospital doorway; or, better still, pasted in your hat.

Rest in bed will do more for more diseases than any other single procedure. The rest cure is not designed alone for wornout nervous systems. With it we can treat heart disease without drugs, tuberculosis without climate, appendicitis without surgery. Without it we can do nothing. Rest seems to tap the great reserve forces of Nature and bring them welling back, to the sick body and the sick spirit.

There is not much that can be written of it, but it is put down here at the beginning in order that we may not forget it, because it is so

plain. Immature faddists are continuously proclaiming the value of exercise: four people out of five are more in need of rest than exercise.

When a body is sick, when a part is sick, let us not stir it up, let us calm it down.

We are always being asked how to cure a cold. An old practitioner of my childhood used to say, "Yes, I can tell you how to cure a cold, but you won't do it." And when urged, "Go to bed for three days," was the answer. True! Too simple a remedy for anyone to think of: we forget what is under our nose.

**Rest of Special Parts.**—It seems to me that there are more violations of the rule of rest in therapeutics than of any other established principle. Giving a cathartic in the face of an acute abdominal pain is an instance. It is almost instinctive on the part of some physicians to do it, but it is very bad therapeutics. Worse than that, it is the principal way doctors kill people, I believe. An acute abdominal pain, not associated with diarrhea in an adult, is usually appendicitis. Other possibilities are gallstone, colic, renal colic, pneumonia, fecal impaction, intestinal indigestion, strangulated hernia and labor. A rare possibility is intestinal obstruction other than strangulated hernia. In most of these the cathartic does no good. In appendicitis—the most frequent—it always does harm; it spreads the focus of infection; it breaks down adhesions; it initiates and develops peritonitis. What is needed is *rest*. I have seen this admonition violated so often that I feel it cannot be overemphasized.

Rest is the most effective therapeutic measure at our command.

## CHAPTER II

## DRUGS

"And lastly, from the day the student enters the hospital until graduation, he should study under skilled supervision the action of the few great drugs. Which are they? I am not going to give away my list. A story is told that James Jackson, when asked which he considered the greatest drugs, replied: 'Opium, mercury, antimony, and Jesuit's bark; they were those of my teacher, Jacob Holyoke.' 'Yes,' replied his interlocutor, 'and they were those of Holyoke's master, James Douglas, in the early part of the eighteenth century.' Mine is a much longer one! The student should follow most carefully the action of those drugs the pharmacology of which he has worked out in the laboratory. He should be sent out from the hospital knowing thoroughly how to administer ether and chloroform. He should know how to handle the various preparations of opium. Each ward should have its little case with the various preparations of the ten or twelve great drugs, and when the teacher talks about them he should be able to show the preparations. He should study with special care the action of digitalis on the circulation in cases of heart disease. He should know its literature, from Withering to Cushny. It should be taken as the typical drug for the study of the history of therapeutics—the popular phase, as illustrated by the old woman who with it cured the Principal of Brasenose; the empirical stage, introduced by Withering in his splendid contribution, a model of careful clinical work of which every senior student should know; and the last stage, the scientific study of the drug, which he will already have made in the pharmacological laboratory. He should day after day personally give a syphilitic baby inunctions of mercury; he should give deep injections of calomel, and he should learn the history of the drug from Paracelsus to Fournier. He should know everything relating to the iodides and the bromides, and should present definite reports on cases in which he has used them. He must know the use of the important purgatives, and he should have a thorough acquaintance with all forms of enemata. He should know cinchona historically, its derivatives chemically, and its action practically. He should study the action of the nitrites with the blood pressure apparatus, and he should over and over again have tested for himself the action, or the absence of action, of strychnine, alcohol, and other drugs sup-

posed to have a stimulating action on the heart and blood vessels. While I would, on the one hand, imbue him with the firmest faith in a few drugs, 'the friends he has and their adoption tried,' on the other hand, I would encourage him in a keenly skeptical attitude towards the pharmacopoeia as a whole, ever remembering Benjamin Franklin's shrewd remark that 'he is the best doctor who knows the worthlessness of the most medicines.' You may well say this is a heavy contract, and one which it is impossible to carry out. Perhaps it is with our present arrangements, but this is the sort of work which the medical student has a right to expect, and this is what we shall be able to give him when in his senior year we give up lecturing him to death, and when we stop trying to teach him too many subjects."—William Osler.

Drugs, after rest, are the most useful and effective therapeutic measures at the physician's command.

There is much superior opinion which contradicts this common-sense statement. A former Harvard professor of anatomy said once it would be worse for the fishes but better for mankind if all drugs were thrown into the sea. Of another Harvard professor of therapeutics it was told that his qualification for the chair was that no man living knew better the worthlessness of more drugs. It is a habit nowadays to hold these lofty and scornful views. It is a habit, too, to state that there are only four (or eight) drugs that have any value.

In spite of these sayings, drugs continue to be the mainstay of treatment: and there are more than eight that are useful. It is the physician who knows best their uses and their contraindications, who selects the proper drug for the proper case, who knows what, when, how, and how much to give, and when to stop—it is he who values drugs at their true worth.

It is that viewpoint that will be emphasized in considering them in this chapter. This is not a study of their pharmacology. We wish to consider here:

What drug to give.
When to give it.
How much to give.
How often.
By what means.
When to stop.
What drug not to give.

To learn these things is to learn an art. To an art there is no end.

## METHODS OF ADMINISTRATION OF DRUGS

1. By mouth.
2. Hypodermically.
3. Intramuscularly.
4. Intravenously.
5. By direct application.
6. By inhalation.
7. By rectum.
8. Inunction.
9. By fumigation.
10. By cataphoresis.

### 1. By Mouth

Drugs may be administered by mouth either singly or in combination. Combination implies writing a prescription.

**Prescription Writing.**—The teaching of prescription writing is a favorite pedagogic pastime. The usual method is to explain laboriously how the seven parts of a prescription should be written. Pious admonitions about legible handwriting, classical simplicity and incompatibility are usually added. It is probably the most unsuccessful method on earth, judged by its results, because few medical students can come fresh from the average lecture on prescription writing and put down one decent common-sense prescription. In my own classes I have adopted the pedagogical method of Mr. Squeers—"when a boy knows this out of a book, he goes and does it. When he has learned that bottiney means a knowledge of plants, he goes and knows 'em."

The usual description of a prescription states that it has seven parts:

1. Name and address of patient.
2. Date.
3. Superscription—℞.
4. Inscription.

    Name of basis............................amount.
    Name of adjuvant ........................amount.
    Name of corrective.......................amount.
    Vehicle .................................amount.

5. Subscription—Misce et fiat solution, etc.
6. Signatura—Sig. Take a teaspoonful every 4 hours.
7. Name and address of prescriber. According to the "Harrison Act," a physician prescribing opium or its alkaloids, or cocaine must

write his patient's name and address in full, including city or town, give the date, his own name and office address, and his internal revenue registry number.

None of this needs any explanation save that the inscription need not contain all of the parts named above, that the subscription is the direction to the pharmacist, and the signatura the direction for the patient.

It is usually advised that prescriptions be written in Latin, except the signatura.

Subscription types:

1. Misce—(imperative)—means "mix."
2. Misce et fiat solutio—"mix and let a solution be made."
3. Misce et fiat—"mix and let be made."
4. Misce et divide in—(adding the number of powders or capsules desired).
5. Fiat decoctum, or Fiat emulsio, or Fiat infusum.
6. Pone—put or place—as put in capsules or cachets.
7. Tere—rub, as "Tere simul et fiat pasta" (Rub together and make a paste).
8. Tritura—triturate or "reduce to a powder."
9. Fac—make.
10. Fac talem—"make such." This is a very useful signature, when you wish to have exact dosage in several powders or capsules. Thus—

℞

| | |
|---|---|
| Strychninae sulphatis | gr. 1/50 |
| Acetphenetidini | gr. ii |

Fac talem dosem in chartes no. xx.

This prescription calls for the exact duplication on the part of the pharmacist in the weighing of each individual dose. It calls for ten powders, each containing $\frac{1}{50}$ grain of strychnine sulphate and two grains of phenacetin. The abbreviation is often written "D.T."

COMMONLY USED ABBREVIATIONS

| ABBREVIATION | UNABBREVIATED FORM | MEANING |
|---|---|---|
| āā | ana | of each |
| a.c. | ante cibum | before each meal. |
| ad lib. | ad libitum | at pleasure. |
| aq. | aqua | water. |
| aq. bull. | aqua bullieps | boiling water. |
| aq. dest. | aqua destillata | distilled water. |
| Aq. ferv. | aqua fervens | hot water. |
| aq. font. | aqua fontana | spring water. |
| b. i. d. | bis in die | twice a day. |
| chart. | chartula | a powder. |
| co., comp. | compositus | compound. |
| dil. | dilutus | dilute. |
| Ext. | extractum | extract. |
| F. ft. | fiat or fiant | let it be made, let them be made. |
| Fl. ext. | fluidextractum | fluidextract. |
| gtt. | gutta | drop. |

## Commonly Used Abbreviations—(Cont'd)

| ABBREVIATION | UNABBREVIATED FORM | MEANING |
|---|---|---|
| M. | Misce | mix. |
| mist. | mistura | mixture. |
| no. | numerus | number. |
| pil. | pilula | pill. |
| p.r.n. | pro re nata | according to necessity. |
| pulv. | pulvis | powder. |
| q.s. | quantum sufficit or sufficiat | as much as necessary. |
| sat. | saturatus | saturated. |
| ss. | semisse | (and) a half. |
| S., Sig. | signa | label. |
| sol. | solutio | solution. |
| s.o.s. | si opus sit | if necessary. |
| stat. | statim | at once. |
| syr. | syrupus | syrup. |
| Tr. | tinctura | tincture. |
| t.i.d. | ter in die | three times a day. |
| ungt. | unguentum | ointment. |

## Table of Weights and Measures

### Metric Measures of Weight

1 Milligram (1 mg.) = 0.001 gram.
1 Centigram = 0.01 gram.
1 Decigram = 0.1 gram.
1 Gram (1 Gm.) = 1.0 gram.[a]
1 Decagram = 10 grams.
1 Hektogram = 100 grams.
1 Kilogram (1 kg.) = 1000 grams.[b]

a = The weight of one cubic centimeter of water at 4°C.

b = The weight of one cubic decimeter of water of 4°C.

### Metric Fluid Measure

1 Milliliter (1 cubic centimeter, 1 c.c.) = 0.001 cubic decimeter.
1 centiliter (10 c.c.) = 0.01 cubic decimeter.
1 deciliter (100 c.c.) = 0.1 cubic decimeter.
1 Liter (1000 c.c.) = 1 cubic decimeter.

### Apothecaries' Weight

20 Grains = 1 scruple (℈).
3 Scruples = 1 drachm (ʒ).
8 Drachms = 1 ounce (℥).
12 Ounces = 1 pound (lb.).

### Apothecaries' Fluid Measure

60 Minims = 1 fluidrachm (*fl*ʒ).
8 Fluidrachms = 1 fluidounce (*fl*℥).
16 Fluidounces = 1 pint (0).

### Equivalents of Apothecaries' Weight in Metric

1 Grain = 0.06479895 gram.
1 Drachm = 3.8879369 gram.
1 Ounce = 31.1034956 gram.
1 Pound = 373.241948 gram.

### Equivalents of Apothecaries' Fluid Measure in Metric

1 Minim = 0.06161 c.c.
1 Fluidrachm = 3.6966 c.c.
1 Fluidounce = 29.573 c.c.
1 Pint = 473.17 c.c.

Metric and Apothecaries' Equivalents (Weights)

| Grams | Grains | Grains | Gram |
| --- | --- | --- | --- |
| 1 = | 15.4324 | 1 = | 0.06480 |
| 2 = | 30.8647 | 2 = | 0.12960 |
| 3 = | 46.2971 | 3 = | 0.19440 |
| 4 = | 61.7294 | 4 = | 0.25920 |
| 5 = | 77.1618 | 5 = | 0.32399 |
| 6 = | 92.5941 | 6 = | 0.38879 |
| 7 = | 108.0265 | 7 = | 0.45359 |
| 8 = | 123.4589 | 8 = | 0.51839 |
| 9 = | 138.8912 | 9 = | 0.58319 |

Metric and Apothecaries' Equivalents (Volume)

| C.c. | Minims | Minims | C.c. |
| --- | --- | --- | --- |
| 1 = | 16.231 | 1 = | 0.061610 |
| 2 = | 32.462 | 2 = | 0.123220 |
| 3 = | 48.693 | 3 = | 0.184831 |
| 4 = | 64.924 | 4 = | 0.246441 |
| 5 = | 81.156 | 5 = | 0.308051 |
| 6 = | 97.387 | 6 = | 0.369661 |
| 7 = | 113.618 | 7 = | 0.431271 |
| 8 = | 129.849 | 8 = | 0.492882 |
| 9 = | 146.080 | 9 = | 0.554492 |

*Practical Considerations.*—Three calculations must be made in any prescription:

1. The total bulk.
2. The individual dose—(as a teaspoonful, or 10 drops, or a wineglassful).
3. The amount of each ingredient per dose.

Total bulks for liquids have by immemorial custom come to be adopted to druggists' bottles—half ounce, one, two, four, six, eight, twelve, and sixteen ounces, equivalent to 15, 30, 60, 120, 180, 240, 360, and 480 c.c.

In calculating amounts of ingredient, the *single dose must be decided upon and multiplied by the total number of doses in the prescription.* A four ounce mixture contains 32 teaspoonful doses approximately. If one grain of any drug per dose is desired and a teaspoonful at a time is directed, the amount to order for a four ounce mixture is 32 grains. The process is usually not so simple. The following formula has been devised:

> *Divide 60 (the number of grains in a dram) by the number of doses in the prescription: then divide the desired dose by the number thus obtained: the result will represent the number of drams to be used.*

Calculation of dosage for children:

1. *Clark's Rule* is based on weight. The average weight of the adult is considered at 150 pounds. Clark's rule is to divide the weight of the

child, in pounds, by the average weight of the adult—150— and take this fraction of the adult dose. Thus: If the child weighs 50 pounds, divide this by 150. or $^{50}/_{150}$ which equals $\frac{1}{3}$. If the adult dose is 15 grains the dose for the child is $\frac{1}{3}$ of this or 5 grains.

2. *Young's Rule* is based on age. Divide the age of the child by the age plus 12; the resulting fraction is the portion of the adult dose which should be used.

3. *Cowling's Rule.*—Divide the age of the child at its next birthday by 24. The resulting fraction is the portion of the adult dose which is to be used.

The last two rules are calculated upon statistics of the weights of children at different ages, and the formulae when worked out give the same results as the first, probably the most dependable method.

*Flavoring and Coloring.*—Vehicles are important for the humanistic and psychologic sides of medicine to say the least. The main reason why proprietary remedies are more generally used, is that they are compounded with pleasant flavoring and coloring.

*Flavoring Vehicles*—

Aqueous—

Bitter almond water—Aqua amygdalæ amaræ.
Anise water—Aqua anise.
Cinnamon water—Aqua cinnamomi.
Peppermint water—Aqua menthæ piperitæ.
Spearmint water—Aqua menthæ viridis.

Syrups—

Syrup—Simple syrup (85% sugar in water).
Extract of malt.

For cough mixtures:
Syrup of wild cherry—Syrupus pruni virginianæ.
Syrup of Tolu.

For children:
Aromatic syrup of rhubarb.
Syrup of acacia.
Syrup of ginger.

To disguise iodides and the salts of mercury:
Compound syrup of sarsaparilla.

Mucilages—for suspensions and emulsions.
Mucilage of acacia—(precipitated by strong alcohol).
Mucilage of tragacanth.

Hydro-alcohol vehicles—

The elixirs—18 to 22% alcohol, generally.

Alcoholic Vehicles—

Tinctures:

| | |
|---|---|
| Tincture of sweet orange. | Tinctura Aurantii Dulce. |
| " " bitter orange. | " Aurantii Amari. |
| " " lemon peel. | " Limonis Cort. |
| " " cardamon. | " Cardamomi. |
| " " vanilla. | " Vanillae. |

Compound Tincture cardamon.
" " genetian.
" " lavender.

Spirits:

Spirits of anise—Spiritus anisi.
" " lavender—Spiritus lavandulae.
" " peppermint—Spiritus menthe pip.
" " spearmint—Spiritus menthe vir.

*Coloring Vehicles.*—Tincture cardamoni composita—contains 50% of alcohol and is miscible with watery and aqueous vehicles. It turns a mixture heliotrope, pink or cherry.

Liquor carmini (N.F.)—rose color. Acids or acid salts precipitate the coloring matter.

Liquor cocci—(N.F.)—rose color. Can be used in acid solutions.

Tincture persiones—(N.F.)—pale pink in acid, lilac in alkaline and neutral solutions.

Tincture persiones composita (N.F.)—brown color, in acid, alkaline or neutral solutions.

Tincture caramelis—ochre.

Tincture lavandulae composita—orange. Precipitates with water and must be filtered.

Tincture croci (N.F.)—yellow.

*Incompatibility.*—Eggleston gives the following summary:

1. Acids:
   (a) Mineral acids often displace the organic acids from their salts.
   (b) Almost all acids decompose the carbonates with the liberation of $CO_2$.

(c) Organic acids, except acetic, when combined with an alkali, generally precipitate the heavy metals, in the form of salts from their aqueous solutions.

2. Alcohol:
   (a) Alcohol, in sufficient concentration, precipitates gums, albumin, and many inorganic salts from their aqueous solutions.
   (b) Inorganic drugs which are insoluble in water are usually also insoluble in strong acohol.

3. Alkalies:
   (a) Free bases and alkaline carbonates and hydroxides precipitate the alkaloids from their salts in aqueous solution.
   (b) Alkalies react with hydrated chloral to form chloroform.

4. Alkaloids:
   (a) The salts of alkaloids, with most organic acids, are insoluble in water.
   (b) Alkaloids are precipitated from their salts in aqueous solution by the alkaline carbonates and hydroxides and by free bases.
   (c) Salicylates, benzoates, iodides, and bromides precipitate most alkaloidal salts from their aqueous solutions in combination with themselves.
   (d) Tannic acid or potassium-mercuric iodide precipitates alkaloidal salts from their aqueous solutions.

5. Carbonates:
   (a) See Alkalies and (b) under Acids.
   (b) Potassium or sodium carbonate in solution precipitates the salts of all other common metals.
   (c) The bicarbonates of the alkaline earths have about the same incompatibilities as the carbonates.

6. Chloral hydrate (hydrated chloral):
   (a) When triturated in a dry state with camphor, menthol, phenol, and some other substances, hydrated chloral forms a liquid.
   (b) Alkalies react with hydrated chloral to form chloroform.

7. Chlorates and other substances:
   When these are triturated dry with any of a number of organic substances, and substances which are readily oxidized, an explosion may occur.

8. Epinephrin:
   This is decomposed by alkalies and the alkaline carbonates and hydroids.
9. Glucosides:
   These are decomposed by mineral acids, alkalies, and ferments.
10. Iron:
    A. Ferric salts:
       (a) Are precipitated from aqueous solution by alkaline hydroxides and carbonates in the form of the reddish ferric hydroxide.
       (b) Tannic and gallic acids give a blue-black solution or precipitate with ferric salts.
       (c) Salicylates and phenol give a violet color in dilute solutions with ferric salts.
       (d) Ferric salts gelatinize acacia in solution.
    B. Ferrous salts:
       Ferrous salts give white precipitates with tannic and gallic acid; these turn black on standing, due to conversion into the ferric.
11. Mercury:
       (a) Mercuric salts precipitate alkaloids, glucosides, proteids, tannin, and antipyrin.
       (b) Mercuric salts of the halogens are precipitated by the fixed alkaline hydroxides, the precipitate being yellow.
       (c) Mercurous salts of the halogens are precipitated by the fixed alkaline hydroxides and by lime-water, the precipitate being black.
       (d) The bichloride of mercury forms the double salt, potassium mercuric iodide, with potassium iodide. This is soluble in an excess of either of the original salts.
       (e) The salts of mercury should not be prescribed in solutions together with the salts of other metals.
12. Oils:
       (a) The *fixed oils* and fats form soaps with alkaline hydroxides, metallic oxides, and limewater.
       (b) The *volatile oils* may be thrown out of aqueous solution by the addition of salts in considerable concentration.
13. Resins:
       (a) Resins form soaps with the carbonates and alkaline hydroxides.
       (b) They are precipitated from their alcoholic solutions by water.

14. Salts of metals:

The salts of most metals precipitate proteids, tannin, acacia, alkaloids, and some precipitate organic substances in general.

15. Spirits:

The volatile substance is thrown out of solution by water in the case of all official spirits except those of nitrous ether and ammonia.

16. Water:

Water precipitates many alkaloids, some glucosides, neutral and bitter principles, resins or resinous matter, and fats or fatty matter, from their alcoholic solutions.

17. Waters (Aquae):

Some soluble inorganic salts, when added to the aromatic waters in considerable concentration, throw the volatile oil out of solution. This is, in part at least, due to the reduction of temperature caused by the solution of the salt, but is not wholly so.

*Notes.*—

For insoluble mixtures—order a "shake well" label.

For poisonous mixtures order a "poison" label.

For medicines for application to skin or douches, etc., order an "External use only" label.

If you do not wish the prescription refilled, write "non repetur" on it.

### 2. Hypodermically

**Selection of a Hypodermic Syringe.**—The student should buy and learn to use a hypodermic syringe, when he gets his stethoscope, knee-jerk hammer and head mirror. There are several kinds of hypodermics he should not get. One is the old metal and glass affair with a leather plunger. They can never be thoroughly sterilized and soon after purchase leak in every joint. Another kind not to get is an all steel one, as you cannot see how much of your solution you have, whether you have an air bubble, etc. Still another disadvantageous type is the glass syringe and plunger with the plunger wrapped in cloth or string to make a tight fit, because it usually does not make a tight fit. Glass syringes in which the needle screws on are not generally as leakage-free as those in which the needle fits on smoothly.

The best syringe is all glass, such as the Luer or Burroughs-Wellcome, or all glass with metal plunger and fittings such as the Record. These can be boiled and do not have any joints to leak.

The proper size needles for hypodermic use are Nos. 26 to 20.

**Technic of the Administration of a Hypodermic.—**

1. Sterilization of syringe, needle, and mixing receptacle.

A. In the well appointed kitchen of your patient's home, boil over the gas range, in a tin kettle, the two parts of your *hypodermic syringe*, the needle, and a spoon.

B. Under less ideal circumstances: Fill a teaspoon with water, immerse the needle in the water and boil over the flame of a match or any other flame. Suck some of the boiling water up into the syringe and discard it.

2. Before dissolving the hypodermic tablet of medicine, suck up the quantity of water you are going to need into the syringe. Put the

Fig. 1.—Various types of syringes. The first four, from left to right, are hypodermics of 2 c.c. caliber. The first two are horrible examples for the student of what to avoid. The first is the old type of metal with a glass barrel and plunger made of some composition like leather. It is impossible of effective sterilization and the plunger is always drying up and getting loose. The second has a glass plunger wrapped with asbestos and a screw adjustment for the needle—both weak features. The next two are all glass syringes of good patterns, the Luer and the Burroughs, Wellcome & Company. The needles at the right of each are No. 26-gauge, the proper size for hypodermic use.

The fifth syringe in line is a tuberculin syringe, it holds 1 c.c. and is accurately calibrated so that any part of a cubic centimeter in hundredths can be measured. The plunger is made of dark glass to facilitate easy reading of dosage.

The sixth is a good form for intramuscular injection of drugs in oily or greasy menstrua as for intramuscular mercury injection; it is made of heavy glass and holds heat well. The needle is size 18-gauge, 2 inches in length.

The seventh is a 30 c.c. syringe for intravenous administration. The needle is size 20-gauge, 1 inch in length.

tablet into the bowl of the empty spoon, and eject the water from the syringe into the bowl of the spoon. After the tablet is dissolved, suck the solution back into the syringe. (I have seen a graduate in medicine fumbling over the preparation of a hypodermic by dissolving his tablet,

only to find he had too much water to go into his syringe.) Fit the needle to the syringe.

3. Prepare the skin area, usually on the arm, with a pledget of cotton soaked in alcohol, ether, lysol, (or cologne, perfume, or soap and water). Put the skin on tension, drive the needle into the subcutaneous tissue, inject the solution, and withdraw the needle, all in one gesture. Rub the needle mark with your alcoholized pledget.

### 3. Intramuscular Administration

A more effective method still, from the standpoint of rapidity of absorption, is to inject the solution into the body of a muscle. It is almost

A. B. C.

Fig. 2.—The technic of intravenous administration of solutions of drugs.

*A.* Shows the tourniquet in place and the operator about to plunge the needle through the skin into the vein. The tourniquet is improvised from the cuff of a blood pressure apparatus. This is the best form of tourniquet possible. The bulb has been squeezed up so that the veins are distended.

*B.* The needle is in the vein as shown by the blood flowing into the syringe. The air is now let out of the cuff of the tourniquet and the solution slowly introduced.

*C.* The solution has been completely introduced. The syringe is empty. The needle is now withdrawn from the vein and the tourniquet removed.

like intravenous administration, as the muscle is a network of fine venules which takes up the drug and carries it quickly into the circulation. For certain drugs this is the only method. Adrenalin for instance is absorbed from subcutaneous administration very little. Other drugs, on the contrary, cause too much inflammation in the muscle to be used in

this way. The muscles usually selected are the biceps for a small amount of liquid, the gluteus for mercury injections, the shoulder or thigh muscles for diphtheria antitoxins, etc.

The technic of administration is identical with that of the hypodermic except that the needle is thrust entirely through the skin into the body of the muscle. (For special points in intramuscular administration of mercury in syphilis see page 44.)

### 4. Intravenous Administration

By intravenous administration of drugs, they are placed directly into a vein and so act upon the nervous system or otherwise systematically very promptly. Certain drugs are not adapted to intravenous administration in their usual form, and in most cases a particular salt or special preparation of the drug is required; so that it is as well to be familiar with the proper preparation before undertaking intravenous medication.

It is, however, a most effective method of administration. It is perfectly safe with good technic. Arsphenamine, strophanthanine, and several other drugs are given intravenously as a routine. Quinine, sodium salicylate, mercury, and others may be used this way when oral and hypodermic methods have failed.

**Technic of Intravenous Administration of Drugs.—**

1. The hypodermic syringe (which must be of glass) or gravity apparatus (see page 169) and needle are sterilized, and the solution to be given prepared as is required for the drug to be administered. The needle should be a little larger caliber than the hypodermic needle, No. 20 or larger.

2. The median basilic vein of the arm is usually used. If it cannot be used or seen, the veins on the back of the hand, the wrist, or the veins around the ankle can be used. The jugular vein can be used. The extremity above the vein is surrounded with a tourniquet. A single piece of rubber tubing will do. A good thing to use is a blood pressure band, as it may be tightened and loosened easily, while still in place. To cause the vein to stand out, allow the hand (or leg) to hang down and have the patient close the fist tightly before compression.

3. The skin over the vein is swabbed with alcohol, or tincture of iodine. Do not smear iodine all over the skin area so that the vein cannot be seen. A single narrow mark, just large enough for sterilizing a place for the needle is sufficient.

4. Make compression with the tourniquet.

5. Push the needle through the skin into the vein.

6. Withdraw some blood, to indicate the fact that the vein has been entered. For the use of drugs like arsphenamine, which cause violent inflammation if they are administered into the subcutaneous tissues, it is absolutely necessary to be certain the needle is in the vein.

7. Remove the tourniquet, or relieve its pressure, order the patient to open his fist.

8. Inject the solution with the syringe, or allow it to flow in if gravity is being used. Do not allow any air bubble to enter the vein.

9. When the solution has been administered, withdraw the needle swiftly, and make pressure with a pledget of cotton for a few seconds. If the vein is ruptured and subcutaneous hemorrhage takes place, make pressure and put on a bandage with a wad of cotton directly over the site of bleeding.

### 5. Direct Application of Drugs

Ointments and lotions on the skin, silver nitrate to the nasal mucous membrane, or tonsils, boric acid in the eye, powders and solutions to the rectal mucosa are examples of direct application of drugs.

### 6. By Inhalation

Drugs may be given by inhalation either for their general effect after absorption or for local effects upon the diseased bronchi. General anesthesia by ether, chloroform and nitrous oxide is an example of the former; the old familiar croup kettle of the nursery, of the latter. (See pages 78 and 152.)

### 7. By Rectum

The use of rectal absorption for drugs is indicated in conditions when there is nausea and vomiting so that the stomach will not retain anything given by mouth, or when it is desirable to limit peristalsis, which is initiated by anything introduced into the stomach, or when it is desired to have a drug absorbed continuously. The limits of absorbing power of the rectum are narrow, and it also exerts a selective action, so that many drugs will not be absorbed from the rectum at all. Salt solution and glucose solutions are probably the most familiar examples of the use of this route. The technic of protoclysis, or continuous administration of salt solution or glucose is given on page 168.

### 8. By Inunction

Inunction is the introduction of a drug into the blood by absorption through the skin. It is, though not necessarily, suspended or in solution in an ointment or oil. The only familiar example of this method is the use of inunctions of mercury in syphilis.

### 9. By Fumigation

Fumigation, consisting of putting the patient in a vapor bath of the drug, is rarely used. The technic is to arrange for a vapor bath but to put the drug to be used over the flame instead of water. The absorption is through the skin. Mercury is the only drug so used.

### 10. By Cataphoresis

Cataphoresis consists of aiding absorption into the skin by the electric current. The drug is placed on the skin, the two poles of the battery placed over the sera, and the current turned on. It is seldom used.

## THE THERAPEUTICS OF DRUGS

No attempt will be made here to consider all drugs, or to deal, at all completely, with the physiologic action of drugs. Only the drugs which are referred to in the second part of this book, are chosen for study. Here we will consider their preparation, dosage, mode of administration and selection for special conditions. Only the important drugs, those with marked pharmacologic action are recommended. Yet, alternatives must, in some instances be presented; because sometimes, in practice the approved drug fails, while the scorned drug accomplishes the desired result. All people are not built alike; some have constitutions that are so ungrateful as not to be affected by the drug that all the faculties of pharmacology approve; for them we must be prepared to offer a substitute.

A word to the student. Concentrate your study on the great drugs: Opium, Belladonna, Digitalis, Quinine, Iodide of Potassium, the Bromides, the Nitrites, Arsphenamine, Mercury, the Cathartics, the Salicylates.

A word to the practitioner. Remember three therapeutic platitudes; do not expect success with a drug, unless you have (1) proper indications for its use—that is unless the altered physiology is that which the action of the drug may reasonably be expected to affect; (2) an active preparation of the drug, (3) the dosage of the drug in proper amounts for therapeutic effect. These may seem childishly obvious, yet in practice I often find them disregarded.

### 1. Drugs Which Have a Specific Action

**A. For Malaria.—**

Quinina U.S.X. Quinine, a white, odorless, bitter powder obtained from cinchona. (Jesuit's bark, Peruvian bark.)

Preparations:

*Quininae bisulphas* U.S.X. White bitter powder, soluble in water (1 to 9) and alcohol (1 to 23). Dose: 1 to 15 grains or 0.1 to 1 gram.

*Quininae hydrochloridum* U.S.X. Soluble in water (1 to 18) and alcohol (1 to 8). Dose : Same as bisulphate.

*Quininae hydrobromidum* U.S.X. Soluble in water (1 to 40) and alcohol (1 to 9). Dose: Same as bisulphate.

*Quininae sulphas* U.S.X. Very slightly soluble in water (1 to 725) or alcohol (1 to 107). Dose: Same as other salts.

*Quininae et ureae hydrochloridum* U.S.X. Very soluble in water (1 to 9) and alcohol (1 to 2). Dose: Same as other salts. For use as local anesthetic 1 per cent.

*Quininae dihydrochloridum* U.S.X. Very soluble in water (1 to 0.6) and soluble in alcohol (1 to 12). Dose: Usually 10 grains intravenously.

Quinine has a long history in medicine. In 1638, the story goes, the Countess of Chinchon, the wife of the governor of Peru, was cured of a fever by the administration of the bark of a tree native to South America. Its use was recommended by the corregidor of Loxa, who had himself been cured of a fever by its use some years before. Under the name, then of Cinchona it was introduced into European medical practice by members of the Jesuit brotherhood, returned from South America, and it hence received the additional name of Jesuit's bark.

It was natural that it should have been used for all fevers, at that time, and the custom has to a certain extent persisted to our day. By virtue of its antipyretic qualities some reason could be adduced for such a use. It was a favorite remedy of the older physicians and the pages of Thousseau, Stokes, Bartholow and others are full of quinine. Binz, twelve years before the discovery of the malarial plasmodium, suggested that its action probably was to kill the then theoretical cause of malaria. Except for malaria, the use of quinine has been somewhat curtailed in later days. It has been replaced by better antipyretics and remedies which make the patient with minor infections, bronchitis and tonsillitis, more comfortable and which can be used in large quantities without disagreeable symptoms such as those of cinchonism.

Its primary property is that of a protoplasmic poison. Binz demonstrated that it paralyzed the movements of amebae, infusoria, and other organisms. No organism, however, is so susceptible to its action as the malarial plasmodium.

Before outlining its mode of administration in malaria it is well to consider certain other uses of the drug, and certain features of its pharmacology, such as its toxicity and mode of excretion. It has a mild antipyretic action, but its action in reducing the fever in malaria is, of course, due to its destruction of the parasites, not to its general temperature-reducing action. It is used extensively in preparations for

Fig. 3.—Quinine eruption.

bronchitis, rhinitis, etc., but it is probably largely inert, in these conditions. Its effect on metabolism, a diminution in destruction of the nitrogenous constituents of the tissues, is probably the secret of the value of the hydrobromide salt in exophthalmic goiter. (See page 735.)

Poisoning by quinine is not common because the symptoms of full therapeutic doses are so marked and so disagreeable that the patient

himself stops the use of it. Ringing in the ears is the most prominent of these. Many persons have an idiosyncrasy to the drug, and develop skin eruptions of various kinds. I have seen a case of quinine poisoning when it was administered by rectum for trichomonas infection, which almost resulted fatally, the patient becoming entirely deaf temporarily and severely prostrated; the outcome however, on simple rest, was favorable. It is excreted partly in the urine, but is largely destroyed in the body, as it does not appear in the perspiration or stools.

In malaria it should be given in a perfectly definite way and according to a perfectly definite plan. It is given in general in too haphazard a manner, and disappointments from its use when they occur usually result from such haphazard methods.

The best plan, I believe, is that advocated by Bass. It is based upon well-determined facts with reference to the life history of the malarial plasmodium, and upon equally well-determined facts with reference to the strength of concentration of quinine necessary to affect the plasmodium in the human body.

These facts, as outlined by Bass, are as follows: (1) The adult plasmodium malariae is destroyed in the blood of a patient who has been saturated continuously for forty-eight hours with quinine. (2) The spores of malaria can live indefinitely in the blood of patients regardless of the amount of quinine taken. (3) Spores remain latent in the presence of quinine in the blood and begin to develop into plasmodia only after the drug has been entirely eliminated from the system. (4) It takes seven days for the spores to develop into adult spore-bearing plasmodia. (5) Quinine must be absorbed in order to do its work, hence the necessity for a preliminary cathartic, a soup diet, and hot water taken with the quinine. (6) The blood must remain continuously saturated with the quinine, hence the importance of administering the remedy regularly night and day. (7) The total amount of quinine necessary is very small.

*The amount of quinine* necessary to kill all the plasmodia in the circulating blood is *10 grains* (.65 gram): 5 grains is not sufficient. More than 10 grains is unnecessary.

*The preparation of quinine to use is the bisulphate.* It should be given in compressed tablets, or in the aromatic syrup of yerba santa: this vehicle disguises the unpleasant taste of the quinine.

*The time of administration of the drug is when the diagnosis is made.* It is not necessary to consider the proximity of the next chill or to wait for a cathartic to act, or for the fever to fall. In certain cases (Class 2 and 3 below) the preparation of the patient is proper and advisable.

Three clinical conditions arise which call for a variation in the method of dosage. The first of these is the pernicious form, in which the patient is either comatose or vomiting, or is so sick that death is imminent. In this case, quinine by mouth is too slow and too uncertain, and *intravenous administration* is necessary. The dihydrochloride of quinine is used: 10 grains in 20 c.c. of normal salt solution. It may be repeated once every 12 hours for two or three doses if necessary. Infiltration of the tissues with the solution during administration will cause some inflammatory reaction.

The second condition is for an acute case with the patient not dangerously ill. Here it may be possible to give a preparation consisting of a cathartic, 2 ounces of castor oil, on the evening before beginning treatment. The patient's diet consists of hot soups only, for the first few days, and he should remain in bed for the same period. On the morning after the administration of the cathartic, the patient is given *2 grains (0.13 gm.) of bisulphate, or hydrochloride of quinine, every 2 hours, day and night for two days and nights.* With each dose he takes a half pint of hot water. An alarm clock may be used in order to render the repetition of dosage exact. After this the patient should take 30 grains of quinine every night for eight weeks. In a less severe case, the first period of rest in bed and two hour treatment may be omitted, and 10 grains may be given every six hours for four or five days, and then 30 grains taken every night for eight weeks. The eight weeks' period of treatment has been arrived at by Bass as the period of time which will disinfect 90 per cent of all cases. If a relapse occurs the course must be repeated exactly and nightly administration continued for three or four months.

The third condition comes up when the patient has been treated for an acute condition and is over it, but has a chill every seven days. This is the form of malaria we meet with most often in temperate climates, and I have used the Bass plan on these cases with marked success. The patient must be prepared with a cathartic and given a two-day rest in bed, during which time he takes 2 grains of quinine every two hours with a half pint of hot water, and soup diet; this is repeated every six days on the day before the chill occurs and the day of the chill for ten weeks or more.

Some people believe that they cannot take quinine, but in most instances they can, and the use of other drugs for malaria is to be discouraged.

*Dosage for Children.*—Bass, after trying smaller doses, believes disinfection cannot be accomplished short of the following doses:

| | |
|---|---|
| Under 1 year | — ½ grain |
| 1 year | — 1 grain |
| 2 years | — 2 grains |
| 3 and 4 years | — 3 grains |
| 5, 6, 7 years | — 4 grains |
| 8, 9, 10 years | — 6 grains |
| 11, 12, 13, 14 years | — 8 grains |
| Over 15 years | — 10 grains |

**B. For Syphilis.—**

I. Mercury—Hydrargyrum.

Preparations:

*Hydrargyri chloridum corrosivum* U.S.X. (Bichloride of mercury, mercuric chloride, corrosive sublimate). Heavy, colorless crystals, or white powder. Soluble in water (1 to 13) and alcohol (1 to 3.8). Dose: By mouth 1/20 grain or 0.003 gram. Intramuscularly in oil ⅙ grain or 0.01 gram.

*Hydrargyri chloridum mite*—U.S.X. (Calomel, mercurous chloride). White, odorless, tasteless powder. Insoluble in water or alcohol. Dose: By mouth 2 grains or 0.15 gram. Intramuscularly 1 grain or 0.1 gram.

*Hydrargyri iodidum flavum*—U.S.X. (Mercurous iodide, Protoiodide of mercury, yellow iodide of mercury). Yellow, odorless, tasteless powder. Almost insoluble in water, insoluble in alcohol. Dose: By mouth ⅙ grain or 0.01 gram.

*Hydrargyri iodidum rubrum*—U.S.X. (Mercuric iodide, biniodide of mercury). Red, odorless, nearly tasteless powder. Nearly insoluble in water, soluble in alcohol (1 to 113). Soluble in solutions of soluble iodides. Dose: By mouth 1/20 grain or 0.003 gram.

*Hydrargyri salicylas*—U.S.X. White or nearly white odorless, tasteless powder. Nearly insoluble in water or alcohol. Dose: Intramuscularly 1/15 grain or 0.004 gram.

*Hydrargyrum cum creta*—U.S.X. Mercury (38%) with chalk. Gray odorless powder. Dose: By mouth 1 to 4 grains or 0.06 to 0.25 gram.

*Unguentum hydrargyri*—U.S.X. Metallic mercury (50%) and oleate of mercury with suet and benzoinated lard. Dose: By inunction ½ dram or 2 gram.

*Mercury succinamide*—Not official. Dose: Intramuscularly ⅙ to ⅓ grain or 0.02 gram daily.

*Mercury benzoate*—Not official. Dose: Intramuscularly ¼ grain or 0.015 gram every second day.

*Mercury oxycyanide*—Not official. Dose: For intravenous use ⅕ grain or 0.012 gram.

*Mercury tannate*—Not official. Dose: By mouth ½ grain or 0.03 gram.

Mercury was the earliest drug used for syphilis. If the idea of the origin of syphilis held by most historians is true, that it was introduced into Europe by Columbus' sailors who acquired it from the Indians, then mercury was used early in the appearance of the disease, because Fracastorius mentions it as a specific in the poem which gave syphilis its name, published in 1530. In the poem a nymph leads the shepherd, Ilceus, who is infected with the disease, to a river. "This other road," she says, "will lead us to the sacred river whose metallic waves carry quicksilver and will furnish thee the remedy that is good for thy disease * * *." "When the sacred stream shall have passed over thy body three times, thou shalt be delivered of thy disease and its impure poison." When the water touches him "his hideous covering dissolves and disappears in a moment." "At the beginning," the poem says later, "mercury was employed associated with lard." "For my part I prefer to alloy it with a mixture of black hellebore, orris root, galbanum, asafetida, oil of mastic and oil of native sulphur. So, without hesitation spread this mixture on your body, and cover with it your entire skin, with the exception of the head and of the precordial region. Then carefully wrap yourself in wool and tow; then get into bed, load yourself with bed covering and thus await until a sweat bathes your limbs with an impure dew. Ten days in succession renew this treatment—very soon you will feel the ferments of the disease dissolve themselves in your mouth in a disgusting flow of saliva, and you will see the virus leave your body in rivers of saliva."

Thus Fracastorius. Sydenham's practice was to give mercury until he got salivation amounting to a pint a day.

Is mercury a specific poison for the Spirochete pallida? Nichols, as the result of experimental work, states that it is far less toxic for it than arsphenamine, and that the parasiticidal action of mercury is just short of the fatal dose for the host. To obtain results with mercury, then, in syphilis the treatment must be intensive. But mercury in small amounts stays in the body a long time. It is eliminated by the saliva, sweat, bile, urine and feces.

During its administration a watch should be held for symptoms of poisoning. Salivation, stomatitis, and nephritis are the most common

of these. The earliest symptoms are those of salivation, which begins with a metallic taste in the mouth, the teeth are sensitive when clicked together, there is an inflammation of the gums and a profuse flow of saliva. There is a bit of folk-lore among physicians to the effect that a syphilitic patient will not become salivated, but it is not true. The nephritis is tubular and much like experimental nephritis, produced with mercury on laboratory animals.

Mercury is given for syphilis in three ways—(fumigation and inhalation are practically obsolete) by mouth, by inunction and by intramuscular injection. The last two are the most effective, because by mouth it is not absorbed so completely.

*By Mouth.*—The following salts are available: protoiodide (undoubtedly the most frequently used and the most popular) the bichloride, the biniodide, the salicylate, the tannate, and the gray powder, the latter used for children with congenital syphilis.

*Inunction* is practiced by using a strong mercurial ointment, about a dram, and rubbing it into the skin until it has disappeared or practically so. Its action is due to its being absorbed by the skin and by inhalation. The dose is rubbed into a different part of the body on each of seven successive nights or days. A hairless part of the body should be selected because mercury rubbed into a hairy part will cause a pustular dermatitis. The following schedule is recommended: first day, inside right arm; second day, inside left arm; third day, inside right leg; fourth day, inside left leg; fifth day, right flank; sixth day, left flank; seventh day, abdomen. Inunction is an extremely efficient method of mercurialization. Its disadvantages are that it is dirty, and patients will not keep it up. Calomel inunctions have been recommended by Schamberg as equally efficient as mercury inunctions. He uses the following formula:

| | |
|---|---|
| Lanolin | 1 gm. |
| Benzoinated lard | 2 gm. |
| Calomel | 3 gm. |

Cole, Gericke and Sollmann have recommended a technic which they call "The Clean Inunction Treatment of Syphilis with Mercury." They point out that inunction is probably by all odds the most efficient method of giving mercury, but that it falls into disfavor largely because it is so dirty. The experimental evidence, however, is against the belief that the excess of mercury left on the skin after an inunction does any good by being inhaled or that if an excess is left on the surface of the skin any part of that excess is further absorbed through the intact skin. It is almost certain, on the other hand, that only that portion of the drug which is forced into the skin during the process of inunction itself is

actually utilized. Therefore it seems reasonable that the excess of mercury should be wiped off after a vigorous thirty minute inunction. The superfluous ointment can be removed with cotton and benzine.

*Intramuscular Injection.*—For this purpose the following salts are used: *Soluble in water or oil*—bichloride, biniodide, succinamide and benzoate,—*Insoluble in oil or lanolin,* the salicylate, calomel and the gray oil.

The technic of intramuscular injection of mercury salts for syphilis is as follows: The gluteal muscle is usually chosen, though the lumbar muscles may be selected. A 2 inch (in length) needle of good size, gauge 18, and a glass syringe are used. The skin is cleaned and painted over a small spot with iodine. The needle is separated from the syringe and plunged into the muscle. It is left there to see that no blood comes through its lumen. This is to obviate the danger of injecting the mercury and its oily solution into a vein. The syringe is then attached and the suspension forced into the muscle. It is well to have a small air bubble in the syringe and to force the plunger clear home, in order to squeeze out all the suspension from the lumen of the needle. The needle should then be revolved once before removal. These last two procedures help to prevent leaving any globules of the mercury suspension in the subcutaneous fat, as this is the cause of much of the pain following intramuscular mercury injections.

X-ray pictures of the gluteal region after an injection of insoluble mercury preparations will reveal a shadow cast by the mercury for some days afterwards. Such studies indicate that the gray oil is unabsorbed for as much as forty-three days, while mercuric salicylate has the best absorption rate, a mean average of four days. Calomel shadows disappear in about fifteen days. These facts indicate that the salicylate is the preparation of choice among the insoluble compounds, the gray oil and calomel both being dangerous.

Abscesses may form, and should be treated by heat, until incision is inevitable.

The menstruum in which to put the mercury has been worked out so satisfactorily by many manufacturing drug firms that any discussion is rather superfluous.

The disadvantage of the intramuscular method is the pain the injections cause. This is a very considerable objection in some cases, in others not.

The intravenous use of mercury is possible. The bichloride has been used but it is likely to cause phlebitis. The oxycyanide can also be used, and without so much danger. The serologic effectiveness of the method has not been investigated.

II. Bismuth.

*Bismuth salicylate*—U.S.X. Dose: 3 grains (0.2 grams) intramuscularly in oil every 5 days. (58% metallic bismuth.)

*Quinine iodobismuthate*—Not official. Dose: 3 grains (0.2 grams). Given intramuscularly suspended in olive oil. (20% metallic bismuth.)

*Precipitated bismuth*—Not official.

*Bismudol*—Not official. Phenylforminate of bismuth in palmitin. (68% metallic bismuth.) Dose: 3 grains (0.2 grams) every 3 to 5 days intramuscularly.

*Potassium bismuth tartrate in oil*—Not official. (68% metallic bismuth.) Dose: 3 grains (0.2 grams) as a single dose intramuscularly repeated every four to seven (preferably every five) days, until ten or fifteen injections are given.

Bismuth as an antispirochetal drug was introduced into practice by Sazarec and Levaditi in 1922. No certain evaluation of its clinical value, therefore, can yet be made. The opinion of competent syphilographers is that it is more active in killing spirochetes than mercury, that it can be used to replace mercury in combination with arsphenamine or neoarsphenamine in early cases, that it has less toxicity than mercury, and that it reduces Wassermann-fast cases better than mercury. Its action on nervous syphilis seems to be effective. Cutaneous tertiary syphilides can be seen to disappear rapidly under its use.

It should be administered with the same technic as for intramuscular mercury. Larger doses were at first recommended but the dosage as given above is the best according to the last reports. The amount of metallic bismuth in any preparation used should be over 50 per cent. The only toxic effect of importance is bismuth stomatitis which must be watched for and treated with sodium thiosulphate when it arises.

III. Iodides.

*Potassii iodidum*—U.S.X.

Iodide of potassium. Crystals or white granular powder. Very soluble in water (1 to 0.7) and soluble in alcohol (1 to 22). Dose: see below.

*Sodii iodidum*—U.S.X.

Iodide of sodium—Colorless crystals, odorless and having a saline taste. Very soluble in water (1:0.55) and freely soluble in alcohol (1:2). Dose: see below.

Potassium iodide was introduced into medicine by Williams in 1831, and popularized by Ricord. It is one of the greatest drugs at our command. It is used in the following conditions:

1. Syphilis—gumma, etc.
2. Aneurism.
3. Arteriosclerosis with hypertension.
4. Lead poisoning.
5. Asthma.
6. Exudates in the eye.
7. Cough and bronchitis.
8. Chronic rheumatism.
9. Actinomycosis.
10. Sporotrichosis and other mycoses.

In syphilis it is used to remove exudates, particularly in neurosyphilis, and for the absorption of gummata. These melt away almost magically under its use. Jobling and Petersen have furnished the explanation of its action on gummata. The softening and removal of caseous material from a gumma are due to a tryptic ferment. If the gumma remains, it is because it contains large quantities of antitryptic substances which are of a lipoid nature, being combinations of unsaturated fatty-acids. These are saturated by the iodine. This liberates the tryptic ferments which proceed to dissolve the gumma.

The dose of KI is variable. It is usually prescribed in the time-honored form of a saturated solution, thus:

℞<br>
KI ℥i<br>
Aquae dest. q.s. ℥i<br>
M. and ft. sol.<br>
Sig: 10 drops t.i.d., p.c. in milk and increase one drop a dose.

One minim of this mixture represents approximately one grain of the salt. It may be taken in water, milk, or coffee. To many people the taste is unpleasant. Others do not mind it. Nothing will entirely disguise it, but milk comes closest. It should be given after meals, as it causes least gastric distress then.

The dosage, for a gumma or other exudate is run up, a drop at a dose, until sometimes two ounces a day are being administered.

Signs of toxicity or full therapeutic effects must constantly be watched for. The first symptom is usually a metallic taste in the mouth, compared by Keyes to the taste of a copper cent in the mouth. Coryza may occur. Indigestion and diarrhea are frequent. The most severe sign and the signal for instant withdrawal is the generalized iodide

rash, the mildest form of an acne, but in severe forms, papules, hemorrhages, purpuric spots, bullæ, etc. They often leave scars for a lifetime.

In the other conditions mentioned above, KI may be given in much smaller dosage—5, 10, 15 grains three or four times a day, exception being made to actinomycosis and other mycoses, in which the dosage is as high as in gumma.

Sodium iodide has been used in the same way and the same dosage as potassium iodide. It may likewise be used intravenously in solution. It is usually used in a 10 per cent solution, giving as much as 150 grains (10 grams) at a dose. Some observers believe that this method is particularly valuable in syphilitic aortitis. Osborne has made a careful study of the comparative value of potassium and sodium iodide by mouth and intravenously. He found that potassium iodide given by mouth and steadily continued results in an even absorption and concentration in the blood. When given intravenously, the iodine content was high immediately but rapidly fell so that there was little left at the end of twenty-four hours. His researches tend to show that mouth administration is more effective.

IV. Arsenic.

*Arsphenamina*—U.S.X. (Salvarsan, 606, arsenobenzol, diarsenol.) A yellow crystalline powder, very unstable in the air, soluble in water (1 to 5). Dose: 0.1 to 0.9 gram.

*Neoarsphenamina*—U.S.X. A yellow crystalline powder, very unstable in the air, and readily soluble in water. Dose: 0.1 to 1 gram.

*Silver salvarsan*—Not official. A dark brown crystalline powder, unstable in the air, and readily soluble in water. Dose: 0.1 to 0.3 gram.

*Tryparsamide*—Sodium N-phenyl-glycinamide-P-arsonic acid. Not official. Dose: 45 grains (3 grams) intravenously once a week.

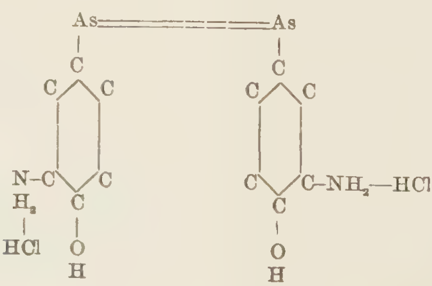
Arsphenamine, originally sold to the profession under the name salvarsan, was the result of the deliberate experimental research by Ehrlich for a chemical compound which would be highly toxic to the Spirocheta pallida, but which would not be toxic for the human body. Ehrlich's whole experimental life was directed towards the same end—the demonstration of chemical affinities between living cells and unorganized chemical compounds; his work on blood stains was a demonstration of the varying chemical affinities of the cytoplasm and the nucleus, while the famous side-chain theory may be taken as the fundamental hypothesis of all his ideas.

Arsenic was the element he selected as most likely to form a compound specific for Spirocheta pallida. In 1909 he made his six hundred and sixth compound and recommended its use. At this time he believed that salvarsan was a sterilisans magna—that one dose would entirely kill off all spirochetes in the body. A widespread and extensive clinical trial of salvarsan was made all over the world, and has resulted in a crystallization of ideas, which represent the best professional opinion of today. The idea of the effectiveness of one single large dose was early given up, the intravenous mode of administration has supplanted all others, and much has been learned about its toxicity and other pharmacologic features.

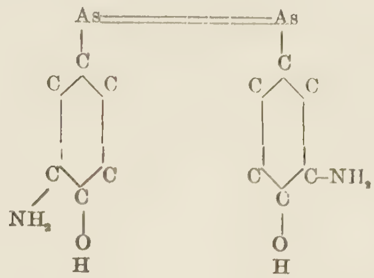
It may be said that, at present, *salvarsan is the best drug we have for the treatment of active syphilis.* It is certainly specifically toxic for the Spirocheta pallida and has the approval of clinicians all over the world.

In the section on the treatment of syphilis in Part II there is considered the use of the drug in the various stages of syphilis, the auxiliary use of mercury and KI, the results in syphilis, and the methods of judging results. Here it is proper to consider some of the many things that have been learned in the decade since its introduction, about its chemistry, preparation, mode of administration, toxicity, dosage, and elimination, as well as the chemistry of later similar products. Before the war the entire supply was imported from Germany, but since the war various American companies have taken up its manufacture; the Council on Pharmacy and Chemistry of the American Medical Association has given it the name arsphenamine to distinguish it from the patented product of Ehrlich, salvarsan.

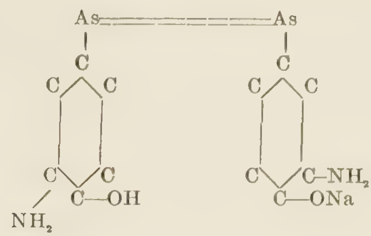
*Chemistry.*—Arsphenamine when the physician receives it from the manufacturer is di-oxy-di-amido-arseno-benzol dihydrochloride. It is soluble in water, acid in reaction, and extremely toxic to man. In order to prepare it for safe use, sodium hydrate is added until the neutral soluble di-sodium salt is formed. The chemical changes that occur, according to McDonagh, are thus:



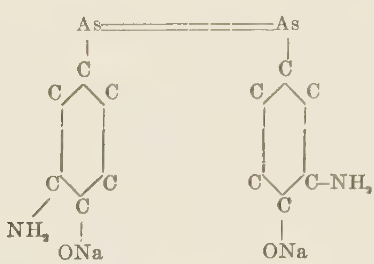
This is the original arsphenamine powder. It is dissolved in distilled water. The addition of some ten or twelve drops of 15 per cent sodium hydrate solution causes the precipitation of an insoluble salt, the arsphenamine base:



NaCl is formed at this point. As more sodium hydroxide is added, the monosodium salt is formed:



This is just soluble in water and about neutral in reaction. It should not be used for intravenous administration yet, but a few more drops of sodium hydrate should be added, until the entire solution is a clear brilliant yellow solution, the disodium salt:



In preparing arsphenamine for the market, numerous processes are gone through too complex to outline here. It cannot be purified by repeated crystallization, neither is there any chemical test for the main toxic element in it and hence biologic tests to determine its toxicity should be made by the manufacturer. Schamberg, who has had a large

experience in the manufacture of arsphenamine, is of the opinion that there is a specific toxic substance which gives rise to the vasomotor reactions; it is of unknown chemical structure, and Schamberg has called it substance X. For biologic tests Schamberg uses rabbits and demands that it be tolerated in the dose of 60 mg. per kilo body weight of rabbit. Rats and white mice have also been used, but Schamberg believes that rabbits are more reliable.

*Dosage.*—It is put up in ampules containing from 0.1 gram to 3 grams. The usual initial dose is 0.2 to 0.3 gram (3 to 5 grains), for a man. If no unhappy consequences follow, the dose may be raised to 0.4 gram for a woman and 0.6 gram for a man.

*Mode of Administration.*—It is practically always given intravenously at present, Sutton being the only dermatologist of note who still uses intramuscular injections.

*Preparation of Solution.*—

Apparatus necessary

For gravity method—

1. 300 c.c. glass cylinder for preparing solutions.
2. Water, freshly double distilled and sterilized.
3. Saline solution, sterilized (0.4%).
4. 4% or 15% solution of c.p. sodium hydroxide, freshly prepared.
5. Glass funnel.
6. Sterile gauze.
7. Two 250 c.c. gravity glass cylinders.
8. Rubber tubing from each cylinder to three-way stopcock.
9. Short tubing for connecting the stopcock and needle.
10. Glass window.
11. Intravenous needles (18 or 20 gauge).
12. Rubber tourniquet.
13. Iodine.
14. Alcohol.
15. Collodion.

For syringe method—

Same, except substitute a 50 c.c. glass Luer syringe for items 7, 8, 9 and 10.

1. The arsphenamine is dissolved in fresh doubly distilled water. It is extremely important that the water be pure and free from all organic material. It should be distilled in all-glass containers and prepared on the same day as the injection is to be given. The dose should be prepared freshly for each patient and under no circumstances should a prepared dose be allowed to stand after preparation, but should be given immediately.

2. The amount of water depends upon the dose of the drug to be given, and whether the method of administration is to be by syringe or by

gravity. Hazen recommends that 17 c.c. of water be used for each one-tenth of a gram of arsphenamine, this giving a nearly isotonic solution. But solutions much more concentrated than this are often used, although their use is not advocated.

3. The temperature of the water should be about room temperature—70° F. Hot water should not be used as reactions may follow.

4. The *ampule* containing the arsphenamine should be immersed in alcohol for 15 minutes before being opened in order to detect any cracks by which air might have entered and oxidation occurred which results in the formation of extremely toxic substances.

5. When the arsphenamine is entirely dissolved in the water, a 15 per cent (or 4 per cent if more extract end-results are wanted) solution of chemically pure sodium hydrate is added, drop by drop, with a sterile dropper. The purity of the sodium hydrate is important. At first a cloudy precipitate forms which dissolves on the addition of more sodium hydrate, the chemical reaction representing these changes having been outlined above. After the solution is clear again, two or three more drops of the sodium hydrate solution should be added to make sure that the di-sodium salt is formed.

6. The solution should be filtered through gauze (not cotton, as it has been thought that some of the cotton fibers getting into the vein has resulted in an embolism). This step is of extreme importance and too often neglected.

*Preparation of the Patient.*—

1. The bowels should be thoroughly cleaned out with castor oil or Hinckle's pills.

2. No meal should have been eaten for four hours before the injection.

3. Evidence of kidney disease makes the administration very dangerous.

4. A skin eruption, other than syphilis, of any extent is a strong contraindication for its use.

5. The patient should be lying down with the clothes about the neck loosened.

6. The median Basilic vein is used if possible, that is, if it can be found and is not obliterated. Sometimes the vein over the ankle, on the back of the hand, or in children the jugular vein may have to be used.

7. The intravenous technic described on page 34 either by syringe or gravity is followed.

*Toxicity.*—Accidents and casualties following the use of arsphenamine:

1. The Vasomotor Reaction: Immediate symptoms of poisoning with arsphenamine may occur within five or ten minutes of administration. The patient begins to complain of tightness in the throat or of dizziness. It is observed that the face is flushed, and the veins on the forehead and neck stand out. The pulse is rapid and bounding. The respirations are deep and frequent. The patient soon speaks of weakness and nausea. The face changes to a deathly pallor, the pulse is slow to 40, 30 or less a minute, the respirations are shallow. Death may occur.

*Treatment:* Lower the patient's head. Give immediately 15 minims of adrenalin solution intramuscularly or intravenously.

Cause of the reaction: Consider:

A. The purity of the water. The presence of organic matter—dead bacteria, etc.—may be the means of rendering the solution toxic.

B. The technic of preparation of the drug—purity of sodium hydrate, too much or too little sodium hydrate, cleanliness of glassware (Pyrex or Jena glassware is preferable). Lack of filtration may be a cause. Filtration catches particles of the drug not wholly dissolved.

C. The rubber tubing. Stokes and Busman, working in the Mayo Clinic, believe that crops of reactions occur when certain brands of new, pure gum tubing are used, in the apparatus with which the arsphenamine is given. After the tubing has been used a while the reactions cease. "New tubing can be rendered harmless and incapable of producing reaction by soaking for six hours in normal sodium hydroxide solution." For the full argument the reader is referred to the original article.

D. The toxicity of the preparation used—presence of substance X. This is unquestionably the usual cause of these severe reactions. A given lot of arsphenamine or neoarsphenamine, marketed at a given time, will give numerous reactions, and will have to be recalled by the manufacturer. This has happened again and again.

2. Delayed reactions consist of nausea, vomiting, diarrhea, possible temperature and chills, occurring from two to twenty-four hours after the administration. The cause may be an idiosyncrasy of the patient, the particular market lot of preparation, the lack of thorough preparation of the patient, or details in technic. They are seldom serious.

3. Infiltration of the subcutaneous tissue. If the drug is injected outside the vein into the subcutaneous tissue a very painful, stubborn inflammatory reaction ensues. When the infiltration begins, the patient usually complains of pain at the site of injection. This is a sign for

immediate discontinuance of the injection. The inflammatory mass often lasts two or three weeks, and may become necrotic. Treatment consists in poultices and heat, bandaging and splinting. Incision need seldom be practiced.

4. Skin Reactions. During the administration of a course of arsphenamine, the physician should exercise an extreme solicitude concerning any symptoms on the part of the patient referable to the skin. Symptoms of itching, or dryness of the skin should be carefully considered. The appearance of an eruption, occurring during treatment, particularly if it is exfoliative, may be taken as an indication for immediate discontinuance. Disregard of this caution may result in one of the most serious of the accidents of arsphenamine administration—desquamative dermatitis involving most of the body surface. The patient is a distressing sight, and death may result, as in a case I saw in consultation. It occurs particularly from what some physicians call intensive arsphenamine therapy—giving large doses, close together. Urticaria and erythema may be the types of reactions. After a severe skin reaction the readministration of the drug should not be begun for at least six months.

Treatment of Exfoliative Dermatitis following the administration of arsphenamine, is by the intravenous administration of sodium thiosulphate. (Dennie.) See page 177. Marvelous improvement occurs under its use.

5. The Jarisch-Herxheimer reaction is the occurrence or the exaggeration of typical syphilitic dermatoses following the use of arsphenamine. The lesions are described as brighter in color than the original eruption and as having considerable infiltration about them. Other forms consist in nervous involvement, particularly facial paralysis (the prognosis of which is good).

*Visceral Changes,* due to arsphenamine:

1. Liver: Jaundice due to arsphenamine has engaged the attention of several internists. Stokes, Ruddeman and Lemon report 70 cases out of 5200 patients receiving arsphenamine. In most instances it runs a mild course, but some deaths have occurred. In those cases which have come to autopsy, changes resembling acute yellow atrophy of the liver have been found. The jaundice does not always occur immediately after the injection of arsphenamine, a period of several weeks, in one of my cases nine, intervening between the administration of the drug and the appearance of the jaundice.

The treatment of the jaundice does not differ from the treatment of acute catarrhal jaundice. Longcope advises a diet low in fats and high

in carbohydrates as in ordinary jaundice. In several of my own cases I have had gratifying results from the Metzler-Lyon method of duodenal drainage by the introduction of magnesium sulphate solution. In severe cases the use of sodium thiosulphate intravenously may save life.

2. Kidneys: Upon diseased kidneys arsphenamine may impose serious changes. Several deaths have occurred due to administration of the drug to nephritics.

Normal kidneys may also be affected. The occurrence of albuminuria and mild hematuria a few days after the injection is not uncommon: compete anuria may occur. The researches of Pearce and Brown with very large doses indicate that a glomerular type of nephritis is the usual lesion, with considerable necrosis of the cortex.

3. Encephalitis is a very serious and relatively frequent accident. It has been studied by Ormsby, Lerrede and Jamin, and by Meirowsky and Kretzmer. Three causes have been suggested: arsenical poisoning, intolerance, and a Herxheimer reaction. It usually occurs after the first injection of arsphenamine, and large rather than small doses. The symptoms are unconsciousness, epileptiform attacks, and death. Autopsy on several cases has revealed some form of cerebrospinal lues.

*Elimination* is accomplished by the kidney and bowel routes. It probably does not stay in the body, after intravenous administration, longer than three days.

NEOARSPHENAMINE.—This drug also was introduced by Ehrlich shortly after the announcement of arsphenamine. It has less arsenic than has arsphenamine, and is less toxic. It has the further advantage that it is soluble and does not require neutralization with sodium hydrate, but can be injected immediately after its preparation. Schamberg states that neoarsphenamine is one-half as efficient as arsphenamine, and one-third as toxic. If so, he argues, a higher dose of neoarsphenamine may be given, with less danger and equal effect. Clinically the results have varied. They will be discussed in the section on syphilis.

Chemically neoarsphenamine is di-oxy-di-amido-arseno benzene monomethane sulphinate of sodium.

The mode of preparation and administration is the same as arsphenamine except that neutralization is not done. The dose should be 0.4 to 0.6 gm. and may be raised to 0.9 gm. later. Distilled water at room temperature, 30 to 50 c.c. for the average dose of neoarsphenamine, is used: 25 c.c. of water or 0.4 per cent saline solution to 0.15 gm. of the drug is recommended. The neoarsphenamine is thoroughly dissolved in the water or salt solution, and no other preparation is necessary. Each dose should be freshly prepared and the solution should not be allowed to stand.

Reactions may be the same as for arsphenamine, but seem not to be quite so frequent.

Silver Salvarsan.—This modification of arsphenamine has recently been exploited, the following advantages being claimed for it:

1. Less toxic to the host.
2. More effective as a spirocheticide.
3. Easy of preparation.
4. Less likely to be followed by reactions.

Combinations of arsphenamine and some of the heavier metals have been used in the treatment of trypanosomiasis and their use is founded on a well established clinical and experimental basis. Silver was particularly valuable. Silver salvarsan is arsphenamine treated with silver salts in such a manner that the silver is relatively firmly fixed in the molecule. It is a dark brown crystalline-appearing powder, readily soluble in water. The clinical result from its use is a matter that is still under discussion. So excellent a syphilographer as Fordyce believes it to be as efficient as the original drug arsphenamine; while Hazen, certainly a trustworthy observer with a large experience, states that he has never seen a Wassermann reaction reversed under its use. All observers agree that there is little toxicity from its use. It is recommended by Fordyce to be particularly valuable in neurosyphilis.

In preparing silver salvarsan for administration the ampule is immersed in alcohol for 15 minutes to detect any leakage, after which it is broken and the powder sprinkled on the surface of 5 c.c. of cool sterile, freshly distilled water in a sterile flask. The salt will go into solution without the application of heat. Neutralization with sodium hydrate is not necessary. After solution is complete, cool 0.4 per cent sterile saline solution is added to the amount of 30 c.c. of solution for one decigram of the silver salvarsan. It may be given, however, and is recommended by some syphilographers in 10 c.c. of solution to one decigram of drug concentration.

Tryparsamide.—Dose: 45 grains (3 grams) intravenously once a week.

*Tryparsamide* has been used particularly for active nervous syphilis. Cases of general paresis respond very favorably to its use in many instances. Its spirocheticidal action is too feeble to justify its recommendation in the early stages of syphilis, but its good effect in the nervous manifestation seems to be independent of this. It can cause optic atrophy and an examination of the fundus should be resorted to in all cases before treatment is instituted.

The dose is 3 grams in solution intravenously repeated once a week. Its effect is probably not so good on paresis as the malarial inoculation, but it is easier for the general practitioner in rural communities to administer.

**C. For Amebae:**

IPECACUANHA—U.S.X. Ipecac. Dose: One grain to 15 grains or 0.06 to 1 gm.

Preparations:

*Fluidextractum ipecacuanhae* U.S.X. Dose: 1 minim; 0.05 c.c.

*Syrupus ipecacuanhae* U.S.X. Dose: 15 minims or 1 c.c.

*Vinum ipecacuanhae* N.F. Dose: 15 minims or 1 c.c.

*Emetinae hydrochloridum* U.S.X. An alkaloid of ipecac. Dose: ½ grain or 0.02 gram by hypodermic.

*Emetine bismuth iodide.* Not official. An orange-red powder with a slightly bitter taste, slightly soluble in water and dilute acids, decomposed by all alkaline liquids. Dose: 3 grains or 0.2 gram a day.

Ipecac has been used since at least the latter part of the 17th Century. In 1682 it was introduced into Europe from Brazil for the cure of dysentery. Thomas Dover recommended it for gout as a component part of his famous powder in 1762. Since then it has been used as an emetic, as an expectorant, and as a diaphoretic. Its use in dysentery has been a story of enthusiasms and disappointments. It was used by the aborigines of Brazil for the many types of intestinal disturbances prevalent there. In Europe, Helvetius, a Parisian practitioner of Dutch birth, used it for many forms of dysentery, and finally cured the Dauphin, son of Louis XIV, who had suffered with a dysentery for many years. The case was naturally soon famous, and Helvetius, who had kept his remedy for dysentery a secret, sold the formula to the royal family. Naturally, again ipecac was used in every form of diarrhea, and even down to quite recent times, well within the bacteriologic era, it was not recognized that it was specific only for amebae. For this reason it fell into considerable disfavor with certain clinicians, who used it in bacillary dysentery and expected results. Strong even asserted that it was of little value in amebic dysentery, as encountered in practice in the Philippines. To Sir Patrick Manson is due the credit for the continuation of faith in ipecac in proper cases, i.e., amebic. The confusing state of affairs was cleared up in 1912 by the introduction of emetine, an alkaloid of ipecac, which, it was found, injected hypodermically, would kill the amebae which were imbedded in the intestinal mucosa and hence

would be out of reach of ipecac in the bowel. In 1915 Du Mez introduced a synthetic combination of emetine for ingestion by mouth, emetine bismuth iodide. Opinion at the present time has considerably crystallized as to the dosage and method of administration of these drugs, although there is some controversy as to the relative merits of emetine hypodermically as against ipecac or emetine bismuth iodide by mouth.

*Toxicology.* Ipecac causes vomiting by its action on the mucous membrane of the stomach. Emetine, for instance, will cause vomiting when taken by mouth, in a dose which produces no symptoms whatever when taken hypodermically. In contrast to this, for instance, apomorphine has a central action and will induce vomiting by hypodermic use, in a dose much smaller than is required by mouth: it acts only after absorption. The dosage of ipecac and its alkaloids should stay within experimentally determined limits, as they can be highly toxic to man. Given in large amounts or over longer periods of time than are necessary it may give rise to symptoms of intestinal irritation, cardiac weakness, and even paralysis of the heart. Pellini and Wallace, working with emetine, found that it would depress the heart and later stop it, that whether by mouth or subcutaneously, it is a gastric and intestinal irritant, and that it causes a derangement of metabolism consisting of an increase in nitrogen loss and acidosis. In patients with any symptoms of cardiac failure, or metabolic disease it should be used with caution.

*The use of emetine hydrochloride for amebic dysentery.* Emetine, in spite of its name, is not the alkaloid of ipecac which particularly possesses emetic properties. Cephalin, another alkaloid, seems to have most of these. Emetine can be given hypodermically with little fear of nausea or vomiting. The hydrochloride salt is quite soluble and is usually used. In chronic cases it may be used: (1) *in doses of ½ grain to 1 grain (0.03 to 0.065 gm.)*, (2) *once in the 24 hours*, (3) *subcutaneously*, (4) *for 10 days.* This course may be repeated after a rest interval of one week. For fulminating cases, emetine hydrochloride may be used intravenously in a dose of not more than ½ grain (0.3 gm.).

"When injected under the skin, the drug is rapidly absorbed and reaches the blood stream in a more concentrated form than by the oral route." (Simon.)

In other forms of amebic infection, as in pyorrhea, emetine may be used.

*The use of ipecac in amebic dysentery.* Method of Rogers as practiced by Simon:

1. *Rio ipecac is preferred*, as it has a higher assay of alkaloids.
2. It is made up in pills of 5 grains (0.324 gm.) each.

3. The preparation of the pill is important. It should be immersed in a bath of melted salol. "Skill is required in obtaining a coating of proper thickness for each pill, which, * * * should not exceed ⅛ of an inch." Each lot of 100 should be prepared fresh. The salol coating is designed to prevent absorption of the ipecac in the stomach and small intestine, so that it may exert its full effect in the colon. If the pills pass through the bowel undissolved and appear in the stool, absorption of the pills given subsequently may be aided by pricking the salol covering in one or two places with a surgical needle.

4. Ten or fifteen of these pills are administered at night, all at one time. Inasmuch as the purpose of the treatment is to concentrate as much of the drug as possible, at one period of time, it is not advisable to divide the dosage.

5. This dosage is repeated every night at bedtime, until 100 pills have been retained. Some of the pills may pass through the bowel undissolved. This may be due to a too heavy coating of salol. The pills which pass in this way should be counted and the number of pills ingested increased the following night. When 100 pills have been retained, the course of treatment may be considered finished.

6. The patient requires some attention during this maneuver. He should be in bed during the entire course. Before treatment is begun on the first day a dose of castor oil should be given. During the first week of the treatment the diet should be liquid. No food should be given for two or three hours before the pills are administered. Several hours *after they are administered*, some nausea and vomiting may occur. Open windows, ice to the neck and lips may relieve this. Morphine and atropine may be given if necessary to induce rest.

*The use of emetine-bismuth-iodide in amebic dysentery.* Emetine hydrochloride cannot be used by mouth as it so frequently induces vomiting, although Menyon and O'Connor have used it in keratin coated tablets, ½ grain for 12 days. Emetine bismuth iodide is nearly insoluble in water and dilute acids, and therefore passes through the stomach unchanged to be dissolved by the alkaline intestinal juices. The minimum amount of emetine in the preparation used should be 26 per cent. The drug should not be compressed into a hard tablet or coated, but given as a powder in a gelatine capsule. Nausea and vomiting and slight diarrhea may be expected, and are an indication that the drug is exerting its effect. If they are not present it is probable the drug is ineffective.

*The dose of emetine-bismuth-iodide is 3 grains a day, for twelve consecutive days. The patient should be in bed on a milk diet during the treatment.*

**D. For Intestinal Parasites:**

(A) Hookworm-uncinariasis.

*Thymol.* U.S.X. Large, colorless translucent crystals, almost insoluble in water (1 to 1010) but freely soluble in alcohol. Dose: See below. Two grains to 1 dram or 0.12 gram to 4 grams.

*Betanaphthol.* U.S.X. Dose: 4 grains or 0.25 gram.

*Oleum Chenopodii.* U.S.X. (Oil of American Wormseed). Dose: 3 minims or 0.2 c.c.

Thymol is a specific poison for ankylostoma duodenale, necator americanus or hookworm. The parasites in man are found mostly in the jejunum and are often deep in the mucosa. To reach them the thymol must be given in as concentrated form as possible, should remain in contact with the empty intestinal wall for several hours, and should then be emptied from the bowel. This means that a treatment usually has to be repeated four or five times, four or five days apart. The guide should be the repeated absence of eggs in the stool, examined a week apart.

Thymol is insoluble in water and probably is absorbed very little from the gastrointestinal tract, unless alcohol or some oil in which it is soluble is ingested. For this reason it is generally stated that castor oil should not be used as a cathartic in preparing the patient. Personally I have seen it given without ill effects, but I do not believe it is so efficient a cathartic as a salt, in this condition, as the salt is better adapted to clean out the mucus from the upper intestinal tract and expose the hookworm. Thymol, if absorbed, may cause depression, nausea, vomiting, roaring in the ears, and collapse. Fatty degeneration of the liver may occur.

A cathartic before and after the dose is given. In the treatment of intestinal parasites the preparation of the patient is equally as important as the administration of the parasiticide.

The patient with hookworm infection should be given the following instructions:

1. Take half an ounce of magnesium sulphate in plenty of water the night before the treatment is to begin.

2. Eat no breakfast the next morning.

3. At 6 A.M. take two 15 grain capsules of thymol. For a child of five, one 3 grain capsule; for a child of ten, one 7 grain capsule, etc.

4. At 8 A.M. repeat the dose of thymol.

5. At 10 A.M. take half an ounce of magnesium sulphate in plenty of water.

6. Drink no wine or other alcoholic beverages on the day you are taking this treatment.

The stool should be examined for several days for the presence of eggs.

Oil of chenopodium has been recommended as a very efficient drug for hookworm infection and should be used if thymol fails. Darling and Smillie, after experimental trial, do not believe a preliminary purge or starvation period add to the effectiveness of chenopodium, but state that a small amount of food taken coincidentally with the drug greatly diminishes its value. They recommend that oil of chenopodium be given in two doses of 1.5 c.c. placed in freshly prepared hard gelatin capsules,

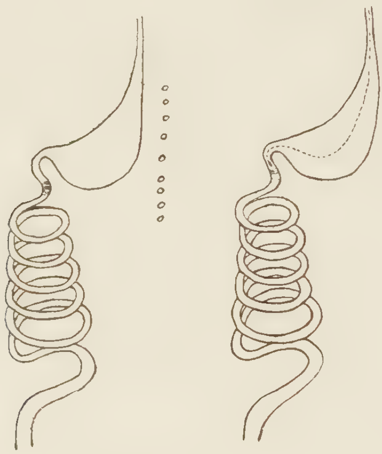


Fig. 4.—Kantor's method of administration of thymol in hookworm infection by means of the duodenal tube. The shaded portion represents the region occupied by the hookworms in the duodenum. Nine capsules of thymol are shown in the left hand figure at the level where they probably dissolve; only two dissolve at the point of infection. In the right hand figure the entire dose is seen delivered by the tube at the site of infection.

and given two hours apart. The last capsule is followed by a purge. The treatment should be repeated ten days later, and possibly a third time. The dose should be smaller for children. Inasmuch as two courses of chenopodium, given ten days apart will get rid of 97 per cent of parasites with little discomfort to the patient, there is no reason why two courses of chenopodium and a week later a course of thymol should not be given.

Kantor recommends the use of the duodenal tube for the administration of chenopodium for hookworm. There is much pathologic support for this in the position of the uncinaria in the gastrointestinal tract,

being high enough up so that a duodenal tube could be passed to the approximate level of the infected area, and the drug applied through the tube directly at the spot. Kantor has given as much as 12 c.c. of chenopodium in this way. He usually used 3 c.c. through the tube and followed it in six minutes with 2 or 3 ounces of a saturate solution of magnesium sulphate. This latter he regards as very important because chenopodium may cause toxic symptoms, and the upper jejunum represents an area where absorption is rapid.

(B) TAPEWORM.

*Aspidium.* U.S.X. Male fern. Preparation: Oleoresina aspidii. Dose: 30 grains or 2 grams. (This dose is usually too small.)

*Granatum.* U.S.X. Pomegranate. Preparation: Fluidextractum granati U.S.X. Dose: 30 minims or 2 c.c.

*Pelletierinae tannas.* U.S.X. Pelletierine tannate. The active principle of pomegranate. Dose: 4 grains or 0.25 gram.

*Pepo.* U.S.X. Pumpkin seeds. Dose: 1 ounce or 30 grams.

*Brayera.* N.F.V. Cusso. Dose: 4 drams or 15 grams. Preparation: Infusion brayera. Dose: 8 ounces or 250 c.c.

The important features about the treatment of intestinal parasites are two:

1. The proper preparation of the patient.

2. To be certain the specific drug is active. Aspidium, pomegranate, etc., are all very likely to deteriorate.

The preparation of the patient is designed to expose the worm. The worms bury the head in a fold of the valvulae conniventes and are covered with mucus and no amount of drug can penetrate to them.

For tapeworm the preparation should be begun three days before the administration of the drug.

First day—Eat only soft food, milk, eggs, soups, gruels, etc.

Second day—Ol. Ricini ℥ ii in the morning. Food as on first day.

Third day—Ol. Ricini ℥ ii in the morning. Food as on first day. Magnesium sulphate ℥ ss in water at night.

Fourth day—Enema in morning. Oleoresin aspidii ʒ i (4 gm.) in capsules is given at 7 A.M. and repeated two hours later in plenty of water, and if the bowels have not moved an hour later a second dose of salts.

Look for the head of the worm in the stool.

These instructions should be typewritten and given the patient.

If the aspidium does not get the head, the same preparation should

be gone through and pelletierin tannate in two doses of 4 grains each substituted for the respective doses of aspidium.

In children pumpkin seeds may be more effective, and are less toxic.

(C) Ascaris Lumbricoides (Thread Worm).

(D) Oxyuris Vermicularis (Pin Worm).

*Santoninum.* U.S.X. Santonin. Colorless crystals or powder, becoming yellow on exposure to light. Dose: 1 grain or 0.06 gram.

*Oleum chenopodium.* See above.

*Betanaphthol.* See above.

*Quassia.* U.S.X. (The infusion is made by steeping one ounce of quassia chips to a pint of water.)

For round worms, santonin is possibly the most effective remedy. The preparation of the patient should begin the day before with soft diet and a dose of two or three ounces of castor oil at night. Santonin should be given early in the morning and breakfast withheld. An hour later a grain of calomel should be administered and two hours later a dose of magnesium sulphate or magnesium citrate. The dose of santonin depends on the age of the patient. One grain (0.065 gram) for a child, up to 5 grains (0.3 gram). The treatment should be repeated the next day, and a week later if parasites persist in the stool. If santonin is ineffectual, chenopodium or betanaphthol or aspidium may be used.

Poisoning from santonin may occur with convulsions or milder symptoms of nausea and vomiting. In certain people, upon therapeutic doses, it causes a peculiar effect upon the retina resulting in "yellow vision." Objects appear bluish and later turn to a yellow color, particularly objects which are brilliantly illuminated, and blue colors appear green. The condition lasts only a few hours.

For pinworm, santonin is also effective and rectal douches of infusion of quassia are a valuable adjunct of treatment, in fact necessary to remove the worms from the lower bowel.

**E. For Acute Articular Rheumatism.—**

*Acidum salicylicum.* U.S.X. A white, odorless powder, slightly soluble in water (1 to 460) and soluble in alcohol (1 to 2.7). Dose: 12 grains or 0.75 gram.

*Sodii salicylas.* U.S.X. Sodium salicylate. A white, odorless powder, soluble in water (1 to 0.9) and soluble in alcohol (1 to 9). Dose: 15 grains or 1 gram or more.

*Salicinum.* U.S.X. Salicin. Dose; 15 grains or 1 gram.

*Acidum acetylsalicylicum.* U.S.X. Aspirin. White crystalline powder, sparingly soluble in cold water, freely soluble in alcohol. Dose: 15 grains or 1 gram.

*Methylis salicylas.* U.S.X. Oil of Gaultheria. Colorless, yellowish or reddish liquid with a wintergreen odor and taste. Dose: 5 to 20 minims.

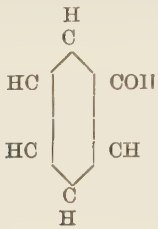
*Phenylis salicylas.* U.S.X. Salol. White powder with an aromatic odor and wintergreen taste. Very little soluble in water, freely soluble in alcohol. Dose: 5 grains or .3 gram.

*Salicinum.* U.S.X. Salicin. Dose: 10 to 30 grains. Purely nontoxic and doses of from ʒ 1 to ʒ 2 are given with no bad effects.

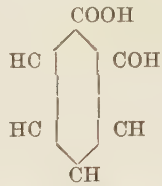
Salicin is a glucoside obtained from several species of Salix and Populus. It is a most valuable bitter tonic, analgesic, antirheumatic, antiperiodic and antineuralgic that has in recent years been overlooked. It is claimed for aspirin that it is as nearly the synthetic duplicate of salicin as can be produced. Salicin distresses the stomach much less than aspirin and can be taken over a longer period of time with no untoward effects. Salicin appears to resolve itself with the hydrochloric acid of the stomach into grape sugar and saligenin; the latter has marked local anesthetic powers and has been used with satisfaction as a clinical anesthetic in strength of from 4 to 10 per cent. Being of purely vegetable origin, salicin commends itself over similar drugs of coal tar origin. Salicin combined with nux vomica and belladonna is highly effective in breaking up grip and other respiratory infections; combined with codeine it gives quick and marked relief from the pain of neuritis.

The salicylates introduced into practice for the treatment of acute articular rheumatism by Maclagan of Edinburgh in 1874, are not true specifics. We have no way of determining whether they even approach to specificity because we do not know the cause of acute articular rheumatism. It will be noticed that the only diseases, for which drugs (as distinguished from antitoxins, sera, etc.) are specific, are those caused by animal organisms. If acute articular rheumatism is due to a true bacterium, and there is every *a priori* reason to suppose it is, the salicylates would be the only group of drugs which even similate a specific action on such an organism. Usually they act with great effectiveness in the disease. Occasionally they fail to affect it noticeably at all. Part of their action is undoubtedly due to their general analgesic action. On account of this some of the salts, particularly aspirin, are extensively employed in headaches, and other pains and aches.

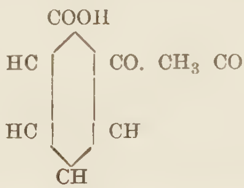
*Chemically* they are related to the phenols.




is carbolic acid or phenol. The introduction of an acid radical gives us salicylic acid:




Aspirin, acetyl-salicylic acid, is formed by replacing the H of the OH group by the acetic acid radical, $CH_3CO$




Salol, phenyl salicylate, is formed by the replacement of $C_6H_5$ for the H of the acid group.

Except for the control of pain and the reduction of the fever and inflammation of rheumatism and as mild intestinal antiseptics, they have no distinct therapeutic effects. Symptoms of toxicity are frequent. The simplest consists in gastric upsets. It was to avoid these that aspirin was introduced into medicine. Buzzing in the ears, dimness of hearing and sight and dizziness are indications for stopping the administration of any of these drugs. More serious are the skin rashes that follow the use particularly of salicylic acid. Retinal hemorrhage has occurred.

Heart failure, by which is meant cyanosis, dyspnea, even the possibility of sudden death have been described following the use of aspirin, particularly, but other members of the group also. It has been supposed that these symptoms were due to direct poisoning. But it has been pointed out that most of the cases occurred after the use of comparatively small doses. Cooke has suggested that these are manifestations of true allergy, and that drug idiosyncrasy in general should be looked on from this viewpoint.

*Mode of administration in acute articular rheumatism.*

1. *By Mouth.*—Salicylic acid is too irritating. Sodium salicylate is the salt usually employed. It should be given in solution, possibly adding some glycerin to disguise the taste.

The amount that will be tolerated is much larger than is ordinarily supposed, and in acute articular rheumatism it should be pushed to the

limit. Hanzlik's studies indicate that the toxic dose of sodium salicylate for a man of average weight is about 200 grains—for a woman between 100 and 200 grains. For children it is only a little less.

It is quite safe, therefore, to give 20 grains (1.30 gm.) every two hours for twelve hours, and in a severe case for twenty-four hours. Practitioners in England where rheumatism is more common, give as much as 200 to 400 grains of sodium salicylate a day and this to children aged sixteen years. After the preliminary massive doses the amount may be reduced.

Sodium salicylate is usually combined with sodium bicarbonate, and the practice seems to be well justified no matter what the reason. It is usually considered that acidosis is prevented and gastric hyperacidity early neutralized. It should be given in a separate solution, grain for grain with the salicylate.

If sodium salicylate causes distress, the other salicylates may be substituted—aspirin, the toxic dose of which Hanzlik found to be about 150 grains for men and 120 grains for women. Methyl salicylate may be used in capsules, in emulsion or in milk. Salicin may be used in the same doses as aspirin.

2. *Intravenous Administration.*—Conner of New York has advocated this method very strongly.

Chemically pure sodium salicylate is used, dissolved in recently distilled, resterilized water. A 20 per cent solution is made up. If protected from light, the solution will keep about a week.

The amount given in the vein is from 10 grains to 30 grains—or 3 to 10 c.c. of the 20 per cent solution. As much as 120 grains a day may be given.

The method gives prompt relief from pain, and amelioration of all symptoms and the stomach is protected.

3. *Rectal Administration.*—This is done by making a thin starch paste, mixing in 60 to 120 grains of sodium salicylate and a few drops of the tincture of opium and injecting it slowly into the bowel every twelve hours.

**F. For Leprosy.—**

*Oleum Chaulmoograe*—U.S.X. Preparation:

1. A combination of ethyl esters of the entire fatty acids of the whole oil, with 2 per cent of iodine by weight chemically combined. Dose: 1 c.c. intramuscularly, once a week, and increased 1 c.c. at every second or third injection until 2 to 6 c.c. are used, according to the weight of the patient.

2. Mixed fatty acids containing 2.5 per cent of iodine in chemical combination. Dose: .184 gram per hundred pounds of the

patient, in capsule, three times a day, an hour or two after meals. The dose is increased every two weeks until a maximum of 1 gram per hundred pounds of weight per dose is reached.

The use of this preparation in leprosy has been referred to recently by those competent to know, as the "nearest approach to a specific." I am unable to offer any first hand information about it but quote above the recommended dosage, administration and preparation. A few references to the literature are appended.

### 2. Drugs Which Affect the Nervous System

**A. Drugs Which Relieve Pain.—**

1. Pain in General—Renal Colic, Gallstone Colic, Peritonitis, etc.

Opium U.S.X. Preparation:

*Gum opium*—Dose: 1 grain or 0.06 gram.

*Extractum opii*—U.S.IX. Extract of opium. Dose: ½ grain or 0.03 gram.

*Opium Pulveratum*—U.S.X. Powdered opium. Dose: 1 grain or 0.06 gram.

*Pulvis ipecacuanhae et opii*—U.S.X. Dover's powder. Powdered opium and ipecac (each 10%) with sugar of milk. Dose: 8 grains or 0.5 gram.

*Tinctura opii*—U.S.X. Laudanum. Dose: 8 minims or 0.5 c.c.

*Tinctura opii camphorata*—U.S.X. Paregoric. Powdered opium and camphor (each 4%), benzoic acid, oil of anise, and glycerin in diluted alcohol. Dose: 1 dram or 4 c.c.

*Tinctura opii deodorati*—U.S.IX. Tincture of deodorized opium. Dose: 8 minims or 0.5 c.c.

Alkaloids.

*Morphinae sulphas*—U.S.X. Morphine sulphate. Dose: ⅛ to ½ grain or 0.008 to 0.03 gram.

*Morphinae hydrochloridum*—U.S.X. Morphine hydrochloride. Dose: ⅛ to ½ grain or 0.008 to 0.03 gram.

*Codeinae phosphas*—U.S.X. Codeine phosphate. Dose: ½ grain or 0.03 gram.

*Codeinae sulphas*—U.S.X. Codeine sulphate. Dose: ½ grain or 0.03 gram.

*Diamorphine hydrochloridum*—No longer official. Prohibited for sale in U.S.A. Heroin hydrochloride. Dose: 1/20 grain or 0.003 gram.

*Aethylmorphinae hydrochloridum*—U.S.X. Dioninum, Dionin. The hydrochloride of a synthetic alkaloid prepared from morphine by ethylation. Widely employed in inflammations of the eye. Internally used to allay cough and relieve pain. Has been found not to equal or replace heroin in effects. Dose: 1/8 to 1 grain.

*Papaverina*—Not official. An alkaloid of opium of the benzyl isoquinoline group (not a morphine derivative). Dose: 1/2 grain to 1 grain or 0.03 to 0.06 gram.

*Pantopon*—Not official. Pantopium hydrochloride. A mixture of all the alkaloids of opium (50 per cent morphine). Dose: 1 grain is equal to 0.6 grain of morphine.

Few physicians would be sufficiently hard-hearted to practice medicine without opium. It has been used by priest and physician since the earliest records we have of man in the Mediterranean basin, although the poppy as such is not mentioned either in Egyptian or Hebrew literature. Paracelsus introduced the tincture of opium, and it was not until 1816 that Sertürner isolated morphine.

The pharmacologic action of opium and its alkaloids has been thoroughly studied. The primary action of morphine, the principal alkaloid, and representative of the whole series, is to depress the entire cerebrum; in full doses a deep dreamless sleep with suppression of voluntary movement and slowing of respiration occurs. The following actions may particularly be picked out:

1. A selective depressive action on pain sensation.

2. Depression and final paralysis of the respiratory center.

3. Contraction of the pupil due to central action on the oculomotor center.

4. In small doses, the induction of nausea, in large doses vomiting. This action Macht believes to be central.

5. Slowing of peristaltic movements of the intestine, and with its continued use, the production of constipation.

6. Lessened activity of secretory glands.

It has little effect upon muscles or nerves in ordinary doses; or upon the circulation, the heart remaining at its usual rate and the blood pressure up; there is some flushing of the vessels of the skin of the face and neck. Metabolism is affected only as the result of slowed respiration and decreased oxygenation.

Comparing the narcotic action of morphine with that of the alcohol-chloroform group, chloral hydrate included, it has a more selective

action on pain and on respiration and less depressant action on the circulation than they have. Death from morphine poisoning results from respiratory failure. With the alcohol-chloroform group the cerebrum, the cord and last of all the respiratory centers are affected.

Excretion of morphine occurs mainly through the digestive tract. It is found in large quantities in the feces even after hypodermic administration.

*Poisoning.*—Acute morphinism is difficult to diagnose from other forms of unconsciousness, but the extreme contraction of the pupils and slowing of respirations may give a clue. In treatment the most important thing is to prevent respiratory failure. Respiratory stimulants, particularly caffeine, should be given. Atropine is a pharmacologic antagonist, but the dosage should not be more than 1/40 grain. In addition the removal of the morphine from the body should be accomplished by lavage, enemata, and the administration of a purge. Potassium permanganate in a dilution of 0.4 per cent destroys morphine by oxidation and may be used in the lavage.

Morphine or opium should never be given to children under one year of age.

*Uses of opium and its alkaloids in disease:*

1. Pain in general no matter of what character.
2. Renal colic.
3. Gallstone colic.
4. Internal hemorrhage (prevents restlessness, peristalsis, etc.).
5. In peritonitis (prevents peristalsis).
6. Diarrhea.
7. Asthma.
8. Acute infections, as a diaphoretic usually in the form of Dover's powder and as a protectant to the heart, to prevent restlessness (in pneumonia).
9. Preliminary to general anesthesia.
10. Diabetes (powdered opium sometimes will squeeze a diabetic sugar free when nothing else will).

*Selection of Alkaloids.*—The alkaloids of opium may be divided into the pyridine group, including morphine, codeine and heroin, and the benzol-isoquinilin group of which papaverine and narcotine are the main representatives. Macht has studied the latter group extensively and has enriched our knowledge of the whole subject thereby. He recom-

mends the use of pantopon, containing both morphine and the benzolisoquiniline alkaloids, in renal and gall bladder colic. He found, for instance, that morphine increases the contractions and tonus of the ureter, while papaverine and narcotine produce a slowing and finally a total inhibition of contractions and of tonus. The work on the gall bladder showed similar results.

The combination of atropine and morphine is one that has come into such general use, that we were surprised to be reminded by Dr. Keen a few years ago, that it had its basis in experiments performed by him during the Civil War. The atropine increases the analgesic action of the morphine, relaxes smooth muscle in colic and seems to prevent the nausea and the respiratory depression of morphine.


Fig. 5.—Diagram of the intestine to show the action of morphine and other drugs on it.

*1.* External longitudinal muscular layer, supplied by the vagus. Stimulation produces pendulum peristaltic movement. Atropine inhibits external longitudinal layer, morphine stimulates external longitudinal layer, and pituitrin stimulates external longitudinal layer.

*2.* Internal circular muscular layer, supplied by Auerbach's plexus. Nicotine stimulates, atropine in small doses stimulates, atropine in large doses paralyzes, and strychnine and pituitrin stimulate.

*3.* Vagus stimulates peristalsis. Morphine and atropine inhibit vagus, and physostigmine and pilocarpine stimulate vagus.

*4.* Sympathetic inhibits peristalsis. Morphine, adrenalin, and nicotine stimulate the sympathetic. Morphine in small doses stimulates the intestinal muscle directly and therefore increases the bowel contraction (tonus).

*Codeine* is much weaker in its action than morphine (1 to 20). It is less toxic, less likely to cause vomiting, and will not cause constipation so readily. It is also less habit forming. From these facts it is easy to select it for use when the indications are proper.

*Heroin* is particularly inhibitory upon the respiratory center, and is much used for cough mixtures. Its habit forming qualities and narcotic action, however, are heavy impediments for it. It is no longer official. Dionin may be tried in its place.

2. Headaches, Migraine, Neuralgic Pains.

*Acetphenetidinum*—U.S.X. Phenacetin. Dose: 5 to 15 grains, or 0.3 gram to 1 gram.

*Acetanilidum*—U.S.X. Acetanilid. Dose: 3 grains or 0.2 gram.

*Antipyrina*—U.S.X. Antipyrine. Dose: 5 grains or 0.3 gram.

*Acid acetyl-salicylic*—see page 62.

*Cannabis*—U.S.X. Preparations:

Extractum cannabis U.S.X. Dose: 1/6 grain or 0.01 gram.
Tinctura cannabis U.S.X. Dose: 12 minims or 0.75 c.c.
Fluidextract cannabis U.S.X. Dose: 1½ minims or 0.1 c.c.

*Gelsemium*—U.S.X. Preparations:

Fluidextractum gelsemii N.F.V. Dose 1/6 grain or 0.01 gram.
Tinctura gelsemii N.F.V. Dose: 4 minims or 0.25 c.c.

Acetanilid and antipyrine were introduced into therapeutics as substances to reduce fever. Inasmuch as we have no chapter in this book on antipyretics they will have to stand as representatives of that group with the remark that they do reduce fever slightly. They were used much more extensively for a time after their discovery for headache and neuralgia, but the cyanosis, anemia and other symptoms of chronic poisoning which occurred from their prolonged use caused them to fall into disfavor. Aspirin has largely taken their place in practice, though it is by no means so effective. Phenacetin does not cause poisoning so frequently and a late preparation, pyramidon, is almost free from all such objection. For a single dose or two though, acetanilid is still the most effective of the group.

In actual migraine an old favorite remedy is cannabis indica. One of the most fascinating of drugs, in certain of its physiologic actions, the practitioner should not forget it in a case of migraine where other remedies have failed. Its dangers, however, should always be guarded.

Gelsemium is another remedy highly thought of by the older generation of therapeutists whom we are nowadays so often reminded were our betters, for use in neuralgias, especially trigeminal neuralgia. It may be given in the form of the tincture, drop by drop, until the physiologic effect—tingling of the cheeks and tongue, or dryness of the fauces—occurs.

3. For Joint Pains, Rheumatism, Gout, etc.

The Salicylates—See page 62.

*Cinchophenum*—U.S.X. Atophan, Cinchopen. Dose: 8 grains or 0.5 gram.

Colchici Cormus—U.S.X. Colchici Semen—U.S.X. respectively the root and seed of colchicum. The seed is usually preferred.

*Tinctura colchici*—U.S.X. Dose: 30 minims or 2 c.c.

*Vinum colchici*—U.S.X. Dose: 30 minims or 2 c.c.

*Colchicina*—U.S.X. Alkaloid of colchicum. Dose: $\frac{1}{120}$ grain or 0.5 mg.

All of the above preparations have a selective action on the kidney, favoring the excretion of uric acid. They also have the ability of lessening pain particularly around joints and along nerve tracts. Phenylcinchonic acid introduced into medicine under the name of atophan, and now in its American products called by the name cinchophen, as authorized by the Council on Pharmacy and Chemistry of the American Medical Association, has by far the most certain and effective action in both these respects of any of them. For that reason it is particularly useful in gout. It does not, however, as was at first hoped for it, reduce the tophi and crystalline masses of gout. It may be used as are the salicylates and colchicum, for any form of arthritis, joint pains, sciatica, etc. The salicylates are too often prescribed routinely in these conditions by the force of habit when cinchophen would act much better in most instances.

Neocinchophen—Not official. The ethyl ester of para-methyl-phenyl-cinchoninic acid. Dose: 15 grains (1 gm.) per hour by mouth, or less, depending on the weight of the patient.

Neocinchophen has several advantages over cinchophen and the salicylates. It is less toxic than any and less irritating to the stomach. It is quite as effective as cinchophen in relieving gouty pains. It is not quite so effective as the salicylates in the treatment of acute rheumatic fever, but it is less toxic and provides a good drug to substitute for them should occasion arise for any reason. Large doses of the drug should be given—from 0.1 to 0.3 gm. per kilogram of body weight repeated as often as once an hour, if toxic symptoms do not supervene. The symptoms of toxicity are similar to those of the salicylates—renal irritation being prominent.

**B. Hypnotics.—**

*Opium*—U.S.X. See page 66.

*Chloral hydrate*—U.S.X. Dose: 8 grains or 0.5 gram.

*Alcohol*—U.S.X.

Preparations: Wines, whiskey, etc. Dose: Variable.

*Barbitalum*—U.S.X. (Diethyl-barbituric acid, *Veronal*). Dose: 5 to 10 grains, 0.3 to 0.6 gram.

*Barbitali Sodium*—U.S.X. Medinal. Dose: 5 to 15 grains, 0.3 to 1 gram.

*Sulphonethylmethanum*—U.S.X. (Diethylsulphonemethylethylmethane, *Trional*). Dose: 12 grains or 0.75 gram.

*Sulphonemethanum*—U.S.X. (Diethylsulphonedimethylmethane, *Sulphonal*). Dose: 12 grains or 0.75 gram.

*Paraldehydum*—U.S.X. Dose: 30 minims or 2 c.c.

*The Bromides*—U.S.X. For description see page 75.

To induce sleep is a necessity in many diseases and conditions. To accomplish it we have many drugs. All of them have the danger of habit formation. The soporifics or hypnotics—veronal, sulphonal, trional, chloral hydrate, and paraldehyde—have a depressant action on the central nervous system, but little effect on pain. In the presence of pain, therefore, opium or some of its alkaloids should be used.

The sedative effect of alcohol, in the form of whiskey, or wine, is too well known to need comment. It exerts its hypnotic effects by quieting apprehensions, by exercising a psychologic change, by inhibiting sorrow and all the restraining influences of judgment, so that the partaker forgets the burdens of the world, his own unimportance, and the illimitable stretch of time. To the patient overwrought with business worries, family sorrows, losses, disappointments, therefore, it is a good hypnotic. But men and women have learned this without the need of consulting a physician. By the fact of its familiarity it is a good drug to illustrate the hypnotics. It teaches us that there is no such thing as an exact dose for these drugs. One person will be affected by very little, another will withstand hogsheads. All the hypnotic drugs have an early stimulating effect and a later depressant effect. Alcohol illustrates this also: its stimulation period is long, but the depressant stage comes with mental torpor, vomiting and sleep. With chloral, veronal, etc., the stimulation period is short, the mental depressant period long. For this reason they are better hypnotics. But any experienced practitioner has seen the patient who is made gay and tuneful by chloral or veronal. Lastly we see in alcohol the possibility of habit formation. It may occur with any drug in the category of hypnotics. I have seen several cases of veronal habit.

But for all their disadvantages, they are good drugs. Their disadvantages must be known, but only in order that we may prescribe them aright, or know when their use is contraindicated. Of the soporifics, to be used in the simple sleeplessness of nervous persons,—invalids con-

fined to bed, and finding themselves awake hour after hour at night,—chloral hydrate is the most certain in its effects. Given occasionally, 10 grains dissolved in a half glass of water, it usually gives pleasant, dreamless and refreshing sleep. It may, in some individuals, as has been mentioned, cause excitement rather than sleep. This is especially likely to occur in topers. I have had patients tell me the effect was like that of a cocktail. For some the dose must be made smaller, for some larger. Veronal, or its sodium salt, medinal, is a favorite, and evidently from its popularity, an efficient remedy with the laity. But in spite of printed expressions to the contrary, it too can form a habit. Trional is an effective drug, probably more certain than veronal, but sulphonal is usually too slow in its action.

Paraldehyde, a colorless liquid, is a good hypnotic for those in whom habit formation is feared, on account of its frightfully bad taste and smell. Yet I have seen a paraldehyde addict reeking of the terrible stuff and begging for more.

The bromides, strictly speaking, are not hypnotics. They repress the motor, not the intellectual centers, and are indicated in motor muscle restlessness. When this is the cause of sleeplessness, they may be used.

**C. Antispasmodics and Spasmodics.—**

1. Belladonna and Atropine—Preparations:

   *Belladonna folia*—U.S.X. Belladonna leaves. Dose: 1 grain or 0.06 gram.

   *Extractum belladonnae foliorum*—U.S.X. Extract of belladonna leaves. One gram represents about 4 grams belladonna leaves: there is a pilular and a powdered extract. Dose: ¼ grain or 0.015 gram.

   *Tinctura belladonnae*—U.S.X. Dose: 12 minims or 0.75 c.c.

   *Atropina*—U.S.X.

   *Atropina sulphas*—U.S.X. Dose: $\frac{1}{120}$ grain or 0.5 mg.

2. Epinephrina—U.S.X. Adrenalin. The isolated principle of the adrenal gland. Usually put up in 1:1000 solution. Dose: (of this solution) 5 to 15 minims, or 0.3 to 1.0 c.c.

3. Pilocarpinae—U.S.X. Pilocarpine. See page 159.

4. Physostigminae Salicylas—U.S.X. Dose: $\frac{1}{60}$ grain or 0.001 gram.

   Ephedrine Sulphate—Not official. N.N.O. Dose: ½ to 2 grains (0.025 to 0.1 grams) by mouth, used as a nasal spray and for ophthalmologic work, and by intramuscular and intravenous injection.

A very illuminating pharmacologic conception of the action of the two sets of involuntary nerve fibers, is that popularized by Gottlieb and Meyer. A glance at the diagram (Fig. 6) will serve to emphasize the points. The vegetative nervous system consists of two sets of fibers, which, in the opinion of Gottlieb and Meyer are antagonistic in their action. These are the sympathetic nervous system, and the autonomic nervous system.

The sympathetic fibers have central origins but always pass through ganglia before being distributed to their end organs. The autonomic system has a direct central connection—the oculomotor, the vagus and chorda tympani above, and the sacral nerves to the bladder and rectum below. Certain drugs will paralyze one whole system—either the sympathetic or the autonomic—leaving the opposite set of nerves in full swing. Some drugs stimulate one whole system.

Epinephrin, for instance, *excites all the sympathetic nerve endings,* causing vasoconstriction, strengthening the heart beat, dilating the pupil, and increasing the flow of saliva. When the sympathetic is inhibitory in function, epinephrin will cause relaxation, as in the stomach, intestine, and bladder.

Atropine *paralyzes* the autonomic nervous system.

Pilocarpine, physostigmine and muscarine stimulate the entire autonomic system. Their actions are antagonistic to the action of atropine. Thus atropine relaxes the intestinal musculature, physostigmine contracts it; atropine dilates the pupil, muscarine contracts it; atropine causes secretions to dry up, pilocarpine causes a flow of sweat and saliva.

There is no drug which picks out the sympathetic and causes complete paralysis. Nicotine paralyzes both systems.

The therapeutic indications for these drugs can be deduced from a study of this conception. (See references at end of chapter. The student should become acquainted with the literature on Vagotonia and Sympatheticotonia.) In the section on diaphoretics I have referred to the use of pilocarpine; in the section on intestinal paresis I have referred to the use of physostigmine.

Those two powerful drugs—atropine and epinephrin—have similar physiologic effects by reason, however, of opposite or rather complementary actions: atropine paralyzes the autonomic and leaves the sympathetic full play, while epinephrin stimulates the sympathetic.

Aside from its use in ophthalmology, atropine is used for intestinal spasm, diarrhea, renal colic, and gall bladder colic. In these conditions it is often combined with morphine, and the combination of their action is nearly perfect for these states. It has been used also in asthma, both

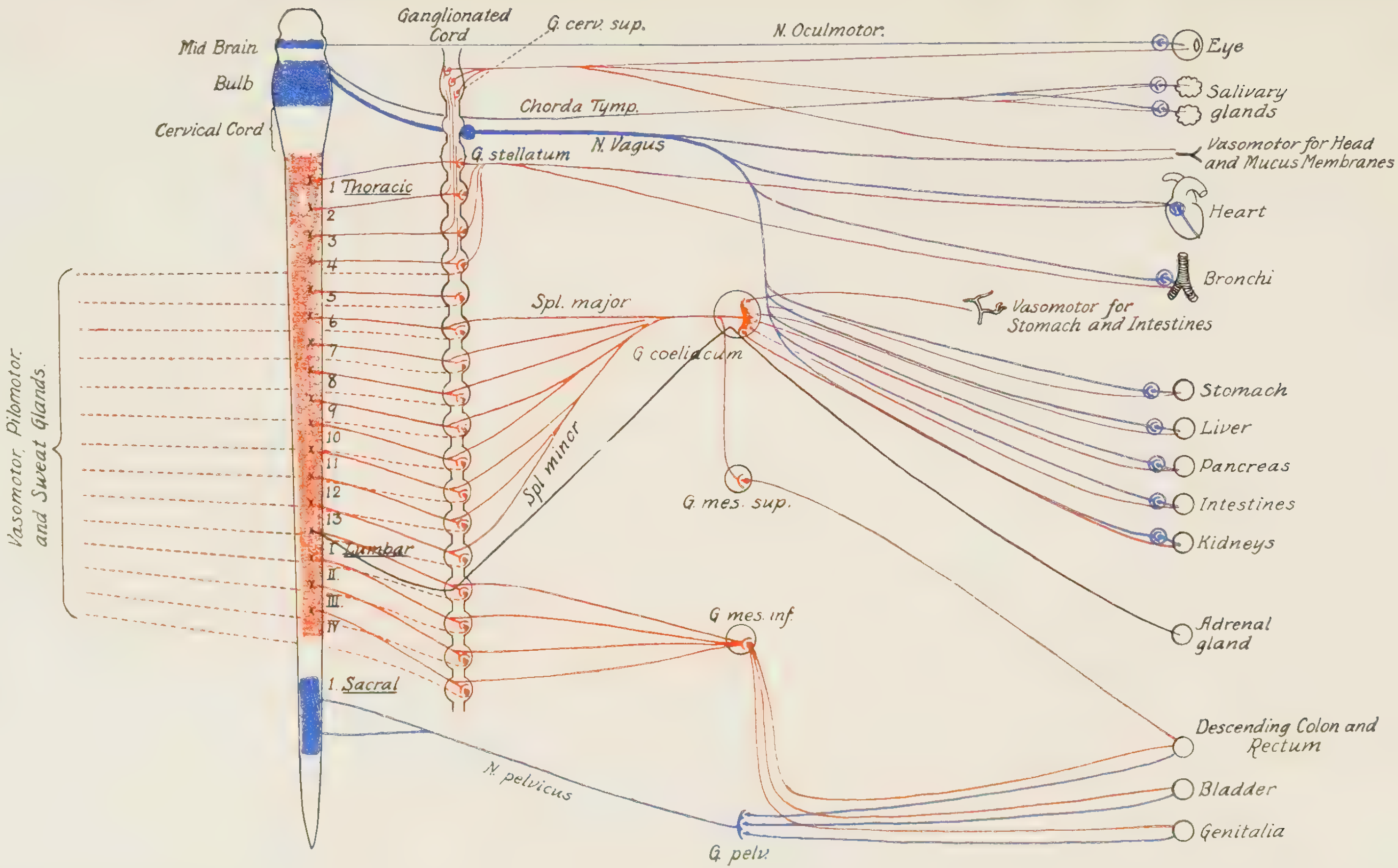



Fig. 6.—Schematic illustration of the vegetative nervous system (from Higier, after Meyer and Gottlieb). Sympathetic fibers are shown in red; the autonomic in blue.

the smoking of belladonna leaves and hypodermically. Certain cardiac irregularities—nodal rhythm—respond to its use. It can also be used to diminish secretion—gastric hypersecretion, etc.

In one condition both epinephrin and atropine are most useful—anaphylactic shock, serum disease, allergic phenomena, etc. In asthma, for instance, which is a typical example of local spasm due to anaphylaxis, both are useful. Epinephrin probably is more generally powerful in its action here than atropine. In the allergic shock following the intravenous administration of some drug such as arsphenamine they are both of value. In skin eruptions due to the use of horse serum or the similar skin eruption of urticaria, epinephrin alone is valuable, because the vessels and glands of the skin are innervated by the sympathetic alone (or at least they act pharmacologically as though they were). Whether it acts in these phenomena in another way—by a direct neutralization of anaphylactic agents—is debatable but doubtful.

Ephedrine is derived from a Chinese plant, Ma huang, and has been used in Chinese medicine for years. Recently it has been introduced into Western practice. Its actions are very similar to those of epinephrin—it stimulates the sympathetic nervous system causing a rise of blood pressure, relaxation of the bronchial musculature, and on local application to the nose vasoconstriction, and in the eye mydriasis. It has the advantage over epinephrin that it is rapidly absorbed when taken by mouth, thus freeing the chronic epinephrin-using asthmatic from the skin irritation and discolorations. In that class of asthmatics in which specific therapy cannot be applied, and who are compelled to use some drug constantly, ephedrine may well be substituted for epinephrin. It will cause the same effects of tremor and palpitation when given in large doses, and in some patients is not so effective as the epinephrin. The effect of ephedrine lasts longer than epinephrin. The dosage must be suited to the patient's idiosyncrasies and needs. Treatment should be begun with small doses (¼ to ½ grain) and gradually raised. Its pharmacologic action as a blood-pressure raising drug acting over a period of several hours makes its use in the collapse of pneumonia, etc., very valuable, not only in theory but also in practice.

**D. Cerebral Depressants.**

1. Bromine: Preparations:

*Sodii Bromidum*—U.S.X. Sodium bromide. Dose: 15 to 30 grains or 1 to 2 grams.

*Potassii Bromidum*—U.S.X. Potassium bromide. Dose: 15 to 30 grains or 1 to 2 grams.

*Strontii Bromidum*—U.S.X. Strontium bromide. Dose: 15 to 30 grains or 1 to 2 grams.

*Ammonii Bromidum*—U.S.X. Ammonium bromide. Dose: 15 to 30 grains or 1 to 2 grams.

2. PHENOL BARBITALUM.—U.S.X. Luminal. Dose: ¾ to 5 grains or 0.05 to 0.3 gram.
3. SCOPOLAMINAE HYDROBROMIDUM—U.S.X. Scopolamine hyoscine. Dose: $\frac{1}{200}$ grain or 0.3 mg.
4. VALERIANA—U.S.X. Valerian. Preparation: Tinctura valerianae ammoniata—U.S.X. Dose: 30 minims or 2 c.c.

The bromides quiet motor muscular restlessness. They are cerebral depressants, but select the motor area particularly for their effects. "Albertoni found that the irritation of the motor area of the dog's brain was very distinctly reduced by the administration of bromides, and in particular that a stimulus which normally would have spread over a wide area and given rise to an epileptiform convulsion, caused only localized contractions after bromides, while convulsive poisons entirely failed to act." (Cushny.)

The reflexes are reduced, and in man under the influence of bromides the induction of nausea and vomiting by reflex stimulation of the back of the throat is abolished. Thus they are ideal for use in epilepsy, except that epilepsy being a chronic disease, and the administration of bromides being necessary over a long period of time, there is the possibility of chronic bromism.

*The symptoms of bromism*—or the prolonged use of bromides, are pustular skin eruptions, resembling acne, digestive disturbances and respiratory hypersecretion; mental sluggishness may occur, but is not, alone, a symptom which necessitates withdrawal. The patient under the influence of the bromides must be carefully watched for the appearance of these conditions.

The dose in epilepsy depends greatly upon the individual patient. The time and the frequency of the attacks, and the determination of the individual's limit of dosage are the factors to be considered. If the attacks come at night, a single dose at bedtime is best, if in the daytime, a single dose in the morning. Each epileptic must find the dose which reduces his attacks to the minimum and stay upon it. It is best to begin with 15 grains (1 gram) and increase as needed up to 90 grains (6 grams). The dose should be given about 4 to 6 hours before the attack occurs. There is no doubt as to its efficacy. In a large epileptic colony the number of fits *per patient* averaged over 13 per month, when no bromides were given, and fell to 1.5 per month under bromides.

Milk entirely disguises the taste, but this practice violates a good therapeutic rule—never give a drug in a food. It may be given in soda water or alkaline waters, and Seguin thinks this reduces the occurrence of acne.

Bromides are used somewhat widely for headache and as hypnotics for sleeplessness. They undoubtedly do some service in this way, but the after-effects—sluggishness and mental hebetude—are such that they cannot be recommended.

Fig. 7.—Bromide eruptions due to taking a nerve sedative for insomnia.

Luminal—phenobarbital—which differs from veronal in that an ethyl group has been replaced by one phenyl group has been used quite extensively in the treatment of epilepsy, in place of bromides. It is considered by those whose experience is wide, to be as effective as they are and it does not have the disadvantages of causing skin eruptions, etc. It is given in doses of one grain once in the twenty-four hours.

In cases of delirium and mania, it may be necessary to use a cerebral depressant much more powerful in its action, and much more rapid; also one which can be used hypodermically, as the patient in such a

condition probably will not swallow a drug. The requirements of the case are met by scopolamine or hyoscine. The drug is not without its danger. It paralyzes the inhibitory terminations in the heart and although for most persons, the ordinary therapeutic dose is too small to have this action, still the susceptible individual occasionally crops up; death has resulted from its use. However the conditions which demand its use are urgent, and cannot be too nicely weighed.

Scopolamine belongs pharmacologically with atropine—it paralyzes the autonomic, causing mydrasis, etc. These effects are, however, subservient to its action on the cerebrum where it causes a depression which is not paralleled by atropine at all. There is sometimes a short stage of excitement, to be followed by a deep sleep which lasts from five to eight hours.

A mild antispasmodic, much used in hysterical spells and fits is valerian. It is probably effective by reason of its perfectly horrible taste and odor; the fear of another dose seems to have a stronger influence with the hysteric than the desire to attract attention.

**E. Anesthetics.**

## GENERAL ANESTHETICS

WRITTEN BY H. C. ANDERSSON, M.D.

1. *Aether*—U.S.X. Ether.

   A clear, colorless, very inflămmable liquid with a characteristic odor and sweetish taste.

   Dosage: see below.

2. *Chloroformum*—U.S.X. Chloroform.

   A clear, colorless liquid with a sweetish odor and taste.

   Dose: see below.

3. *Nitrogenii monoxidum*—U.S.X. Nitrous oxide. Laughing gas.

   A colorless gas with very slight odor and taste.

4. *Aethylis chloridum*—U.S.X. Ethyl chloride.

   A colorless liquid with sweetish odor and taste. Very inflammable.

A brief summary of the history of anesthesia (Luke).

1798. Sir Humphry Davy cut a wisdom tooth under nitrous oxide gas.

1842. Dr. Crawford Long, U.S.A., gave ether with success for some surgical operations.

1844. Horace Wells, Hartford, Conn., gave nitrous oxide gas for dental extractions and attempted to demonstrate its action but the demonstration was a failure.

1846. W. T. G. Morton, (dentist) pupil of Wells, used ether with success for dental extractions, and on the seventeenth day of October of the same year for a surgical operation at the Massachusetts General Hospital—Dr. Collins, operating. The first operation under ether in an English Hospital took place at University College Hospital on the twenty-first day of December, 1864.

1847. Sir J. Y. Simpson employed ether for the first time in midwifery practice on January 19. Later in the same year he introduced the use of chloroform for anesthetic purposes.

In 1848, the twenty-eighth day of January, Hannah Greener, the first victim to chloroform, died, Sir James Simpson himself being the anesthetist.

1858. Dr. John Snow's classic work "On Chloroform and Other Anesthetics" appeared.

1868. Dr. Evans demonstrated the values of nitrous oxide at the London Dental Hospital.

1877. Dr. Clover invented his portable regulating inhaler—the most valuable anesthetic mechanism ever introduced.

1879. Glasgow Committee of British Medical Association met and condemned the use of chloroform.

1889. The first Hyderabad Commission met.

1890. The Second Hyderabad Commission met and concluded that chloroform was a comparative safe body, used properly.

1901. The British Medical Association Committee published a fresh report again condemning the use of chloroform.

1909. Ethyl Chloride was introduced into the United States as a general anesthetic.

*Requirements of a General Anesthetic.*—The requirements of any anesthetic are, as Dr. Bevan has pointed out: (1) safety (that, of course, is the prime requisite of any anesthetic), (2) comfort, (3) efficiency, (4) control, (5) simplicity and general adaptability, (6) minimum after-effects, (7) minimum effect on immunity, tissues, pus organisms.

But besides these there are a number of factors which every anesthetist takes into account, whether consciously or unconsciously:

1. The operator, his habits and disposition.
2. The freedom of choice accorded the anesthetist.
3. The patient, past history and condition.
4. The operation, extent and circumstances under which performed.

*Relative Safety of General Anesthetics.*—Statistics regarding the death of anesthetic agents, although open to grave fallacies, show that ether is by far the safest general anesthetic we have, with the exception of

nitrous oxide combined with oxygen. In reviewing these statistics it is a noticeable fact that the death rate both immediate and late, under the more experienced anesthetist, is so much lower than in the hands of those not skilled in this line of work that it would seem that deaths are due more to faulty anesthesia or the selection of the anesthetic unsuited to the case rather than to the anesthetic itself. The most reliable statistics from all parts of the world give an average of one death to about every sixteen thousand administrations of ether and one in 750 from chloroform. Dr. Julliard of Geneva reports from various reliable sources 314,738 administrations of ether with 21 deaths, or a death rate of one in 14,987. Dr. Ormsby, of Dublin, reports 92,815 ether administrations with but four deaths, or one in 23,204. Prof. Tripier reports 6,500 cases without a death, Alice McGraw 15,000 personal cases without a death. Dr. Rabatz reports 150,000 cases of ether administration without a death; Turnbull reviews the literature (1888 to 1895) of 11 cases of death from ether. Death occurred in less than one minute after the administration was begun in three cases and within a few minutes in four of the other cases. One patient died during the operation and one at the end of one and one-half hours. The time of death of the other two patients is not recorded.

It appears that most deaths from ether occur during the stage of excitement or before complete narcosis is established, and are probably due to functional disturbances of reflex origin. In deaths from ether it rarely happens that cardiac failure precedes respiratory failure. Deaths that occur during the surgical stage of anesthesia appear to be due to anesthetic shock.

*Preparation for Anesthesia.*—Before taking up the physiologic action of anesthesia in general, the different methods of administration and the dangers and advantages of each, I wish to say a few words regarding the use and abuse of morphine and atropine preliminary to any anesthetic.

There is nothing that will aid a general anesthetic more than the proper timing and the proper selection of the amount of drugs to be used. In 99 per cent of all cases involving a general anesthetic the greatest danger period lies in the induction period. An ill-timed hypodermic, with the maximum physiologic effect of the morphine taking place simultaneously with the surgical anesthesia from the anesthetic, will always invite trouble. Hypodermic medication of any kind should never be undertaken unless the operator is advised of its administration. Never undertake to induce surgical anesthesia until the effect of the hypodermic has reached its height.

Morphine and atropine hypodermically can be used to advantage one-half hour before general anesthesia, but it should not be used in every case and the dosage should not always be the same. It is generally known that while the action of morphine is usually constant it sometimes produces the reverse of the result desired. Instead of quieting the patient it produces excitement. Instead of producing sleep it adds to the nervousness. From animal experiments and from observations in man, it would seem that the morphine produces undesirable or reverse effects, if the autonomic nervous system is in a state of hypersensitiveness. This is generally associated with a dilated pupil. It cannot be stated dogmatically that the pupil indicates the condition of the autonomic nervous system, or that a contracted pupil contraindicates the use of morphine, but I believe that the pupil is the most reliable guide in using morphine. Harley, Loewig, Cushing, Waller, Scheidler and others have observed that in animals where morphine produced stimulation, irritability, increasing reflexes and convulsions as it does in mice, cats, frogs and dogs, it causes dilatation and not contraction of the pupil. Botelli has shown that when morphine produces vomiting and diarrhea in animals as it does in dogs and cats it also produces dilatation of the pupil. I have observed the same phenomena in human beings and have come to expect a reverse action of morphine if it is given to a patient with contracted pupils and who is in severe pain. I believe that the ancient dictum of Sydenham that pain indicates morphine and is an antidote to morphine, should be observed. I believe that every patient who has pain before operation should be given morphine; those who have no preoperative pain and who have normal and dilated pupils should also have morphine, while the nervous and excited patient who has no preoperative pain and whose pupils are contracted should have no morphine. By observing these rules I have had no untoward effects from morphine. The ordinary dosage is one-sixth grain of morphine and 1.150 grain of atropine.

In regard to the use of atropine, I agree with Henbrach, Lenhartz, Bing Wallmer and Servison, who believe that its greatest indication is to counteract the depressing effects of morphine on the respiration, and we make use of it almost solely for this purpose.

I. Ether.—

*Sulphuric Ether.*—It is most commonly prepared by the action of sulphuric acid upon ethyl alcohol forming ethyl sulphuric acid and water. With an excess of alcohol, ether and sulphuric acid is the end result.

$$C_2H_5OH + H_2SO_4 = C_2H_5HSO_4 + HO$$
$$C_2H_5HSO_4 + C_2H_5OH = C_2H_5OC_2H_5 + H_2SO_4$$

Ether deteriorates on exposure to air and the oxidation products so formed are extremely irritable to the mucous membranes of the respiratory passages. Absorption of these products is extremely injurious to the patient by producing a marked acidosis. Anesthetic ether is usually marketed in quarter and half pound sealed cans.

*Physiologic Action.*—

*Respiration.*—During the stage of excitement in the induction period of ether anesthesia the rate of the respiration increases, the rhythm remains normal, while the amplitude somewhat deepens. As the depth of anesthesia increases the rate increases, the rhythm may become irregular on account of choking and swallowing and the amplitude will vary a great deal. When full, deep anesthesia has been established, the rate will remain increased, the normal rhythm maintained and the amplitude variable. Manipulation of certain reflexes, such as pelvic or gall bladder manipulation, will produce a change in respiratory rhythm and a possible cessation may occur. Decreasing the depth of anesthesia invariably results in shallow breathing. However, shallow breathing, in the presence of abolished eye reflexes, means paralysis of the nervous system and the anesthetic should immediately be stopped.

*Heart.*—The direct effect of ether upon the heart is problematic. Some writers maintain that there is a direct depressing action upon the heart, resulting in a hypostasis, while others explain this action as a central nervous system depression.

*Pulse.*—During the stage of excitement and rigidity the pulse is accelerated to a marked degree, generally decreasing in rate during the stage of maintenance. Of course the blood pressure has a decided influence upon the pulse rate throughout anesthesia.

*Blood Pressure.*—In presenting the value of blood pressure guides in operation and surgical prognosis A. H. Miller, of Providence, Rhode Island, emphasizes the value of Moot's rule for determining the index of the patient's resistance. This rule may be thus stated: The pressure ratio (a fraction having the pulse pressure as numerator and the diastolic pressure as denominator) may be normal between 40 and 60 per cent. If the ratio lies between 25 and 75 the case is probably operable; if outside these limits it is probably inoperable. In checking up the accuracy of this rule in a series of one thousand cases Miller found that in the operable risks 3.23 per cent of the patients died and 96.7 per cent recovered. In the inoperable risks 23.07 per cent of the patients died and 76.93 per cent recovered.

In order to standardize the surgeons' and anesthetists' conception of circulatory depression the following degrees established by Moots and

Miller have been accepted by the National Anaesthetic Research Society and included in their uniform anesthesia record. These degrees of circulatory depression are:

1. Safe. Ten to 15 per cent increase in pulse rate with 15 to 25 per cent decrease in blood pressure.

2. Fatal. Progressively increasing pulse rate above 120 with progressively falling blood pressure of 80 mm. or less systolic, and 20 mm. or less pulse pressure for more than twenty minutes.

It is the consensus of opinion of investigators that in ether anesthesia there is first a rise in blood pressure corresponding to the excitement stage of anesthesia, which is followed by a marked fall in blood pressure in the third, or maintenance stage.

Manipulation of the abdominal viscera and dilatation of the sphincter ani has an excitory effect on the patient, thereby raising the blood pressure.

*Pupil.*—Ether has a marked effect upon the dilator and sphincter muscles of the iris of the eye. Use is made of this action to ascertain the depth of the anesthesia. One of the most important signs exhibited in profound anesthesia is a contracted, fixed pupil, which neither dilates nor contracts upon the admission of light. During the induction period the first effect of ether upon the nervous control of the pupil is a stimulation of the sympathetic system producing dilatation of the pupil. (In some cases where morphine has been given before the operation the irritability of the sympathetic system is greatly reduced and this dilatation may be very brief and occasionally absent altogether.) Further concentration of ether brings about a paralysis of the sympathetic system and a slight stimulation of the central nervous system, resulting in the contracted pupil. Should the ether tension be further crowded, a paralysis of the central nervous system will result, with the accompanying dilatation of the pupil.

*Methods of Administration.*—The Open Method.—The open or drop method is conceded to be the safest and the most generally used. The open or drop method consists in the use of a small metal frame work (Esmarch or Schimmelbusch) covered with gauze in sufficient quantity to exclude a too large percentage of air, on which the ether is continuously administered by drops.

Advantages.—1. There is little or no rebreathing which interferes with oxygenation, no increase of carbon dioxide or poisoning from exhaled organic substances.

2. It permits of administration of a safe and uniform ether vapor.

3. The induction period with low vapor strength does not produce a feeling of suffocation, and induces an anesthesia with a minimum of distress to the patient.

4. The full oxygenation of this method is conducive to complete muscular relaxation and prevents exaggerated abdominal breathing.

5. Its simplicity and adaptability for the inexperienced anesthetist.

6. Its safety has been demonstrated by extensive usage.

Disadvantages.—1. Produces great refrigeration. Whatever heat is taken from the inspired air by the vaporization of the ether is in turn taken from the lungs, as the exhalation is always at practically body temperature, regardless of the temperature of the inhalation. Experiments have demonstrated that a room at 80° F., 2.1 per cent ether vapor reduces the inhalations to 30° F. and 5.4 per cent ether vapor to 9° F., thus causing a loss of about twenty-one thousand calories of body heat for each ounce of ether used. If refrigeration is a factor in the production of postanesthetic pulmonary complications the open or drop method, which is the most efficient of all methods in extracting heat from the patient, would seem to incite the occurrence of postanesthetic pulmonary involvement. If refrigeration adds to shock the open or drop method would, regarding the production of shock, head the list of all the methods of administering ether.

2. Incomplete diffusion of ether vapor and air because of the close proximity of the liquid ether to the face.

3. Unduly large amounts of ether required because of the waste of ether from its vaporization by exhalation.

4. Room may become saturated with ether vapor during long anesthesia.

5. Longer time necessary to induce anesthesia.

Semiopen Method.—This is obtained by a modification of either of the preceding methods so that the air supply may be controlled, thus causing a limited amount of rebreathing.

The appliances used are usually:

1. The mask as used in the open or drop method with additional layers of gauze, or gauze surrounded by towels.

2. A cone containing gauze with both ends open.

3. Any of the several inhalers with mechanical devices for limiting the air supply.

The semiopen method partakes of the advantages or disadvantages of the preceding methods to the degree that it approaches one or the other.

Closed Method.—This is obtained by fitting a closed cone closely to the face or by the use of inhalers provided with pliable bags for the pur-

pose of rebreathing. The more flexible the material of which the cone is made the more it will permit of rebreathing. This is the method of choice in the senile.

Advantages.—1. The rebreathing gives a much quicker narcosis.

2. Only a small amount of refrigeration because of the retention of the warm exhaled air.

3. A good diffusion of ether vapor and air, therefore less irritation and less chance of a hypersecretion of mucus.

4. A small amount of ether is necessary because of the rebreathing.

Disadvantages.—1. The rebreathing causes a decreased oxygenation which predisposes to toxic effects of the anesthetic agent. It also gives a respiration greatly increased in carbon dioxide and produces toxic effects from the organic materials of expired air.

2. It is impossible to regulate the dosage (even approximately) because of the necessity of pouring the ether into the cone or inhaler intermittently. This uneven administration permits of the possibility of exceeding the safety margin and also predisposes to anesthetic shock.

3. The method is very disagreeable to the patient because of a feeling of impending suffocation in the first stage, which often causes extreme fright and struggling.

*Mechanical Administration.*—Another method of administering ether is by means of apparatus by which the strength of the ether vapor is controlled mechanically by definite percentage, thus giving an evenly measured dosage. Excessive refrigeration of the inhalation is prevented by means of radiation from a chamber of warm water. But little ether is used because the exhalation does not come in contact with the ether. There is practically no rebreathing. These apparatuses have the advantage of simplicity and the passage of the inhalation through the apparatus gives a thorough mixture of air and ether vapor.

*Rectal Etherization.*—Various apparatuses have been used for rectal etherization, some of which have met with fair success.

Advantages.—1. Postoperative nausea and vomiting have been practically absent with this method and recovery rapid.

2. It is well suited for operations on the nose and mouth because the anesthetic materials are out of the way.

3. It is well suited in cases of extreme pulmonary or bronchial involvement.

4. A small amount of ether is used.

5. It is not disagreeable to the patient. There is little or no stage of excitement.

Disadvantages.—1. The induction is usually long.

2. It fails to produce anesthesia in some cases.

3. It is difficult to regulate the dosage.

4. Colicky pains, diarrhea and painful distention sometimes follow this method of etherization. This method has had some fatalities, although it has been used without a fatality in a series of fifteen thousand cases.

II. Nitrous Oxide.—

*Nitrogen Monoxide,* or Laughing Gas, $N_2O$, was discovered in 1772 by Priestley and first used as an inhalation anesthetic by H. Wells of Hartford in 1844.

It is a nonirritating gas, with a sweet odor and taste. It is not inflammable. Nitrous oxide is marketed as a liquid under terrific pressure in vanadium steel containers. These containers hold about 3,200 gallons of the gas. The use of nitrous oxide alone is confined mostly to anesthetics such as are given for extraction of teeth, opening abscesses, etc. During induction of nitrous oxide $N_2O$, or nitrous oxide-oxygen anesthesia, the eye balls generally are moving, either from one side to the other or up and down. Eye balls which are fixed, staring straight ahead indicate profound anesthesia, especially if the pupils are inactive and somewhat dilated. The respiration is always increased in both rate and amplitude during any type of nitrous oxide anesthesia. The respiration is immediately restored to normal when the mask is removed.

The color is no doubt the most valuable sign in this type of anesthesia. Duskiness, or cyanosis, indicates asphyxia and should be avoided. Death in nitrous oxide anesthesia usually results from paralysis of the respiratory center. The blood pressure reacts practically the same as in ether anesthesia, while the pulse rate and amplitude are dependent upon the stage of asphyxia. Nitrous oxide causes very few histologic changes in the tissues but does increase the H-ion concentration to a marked degree. The use of ether and nitrous oxide as a control to induce muscular relaxation is now being employed with the greatest success. The reaction of the respiration and pulse to this method is the same as with straight ether, with the exception that the respiration remains fuller in amplitude than in the case of ether alone.

*Nitrous Oxide-Ether Sequence Method.*—This is obtained by several different apparatuses, Clover's, Hewitt's, Bennett's, Pedersen's and others, by which nitrous oxide is given until narcosis is obtained, then followed by ether vapor and nitrous oxide, then continued with ether vapor and air. It is necessary for the gas-ether apparatus to employ the aid of anoxemia by the use of a rebreathing bag to maintain narcosis between the discontinuance of the gas and until the state of complete

etherization is obtained. It is necessary to discontinue the administration of the gas early because of the asphyxiation which would follow otherwise.

Advantages.—1. Since narcosis is produced first by gas, the odor of the ether and distress of the induction period are abrogated. Thirty seconds is usually sufficient to produce nitrous oxide narcosis.

2. Surgical ether anesthesia is obtained in from two and one-half to four minutes.

3. Statistics show that the gas ether sequence is much safer than the administration of ether alone. This is probably due to the elimination of the stage of excitement, which is the most dangerous stage of anesthesia

4. A small amount of ether is necessary to continue anesthesia because of the rebreathing of this method.

Disadvantages.—1. It requires considerable skill for its administration

2. The cyanosis from the gas and the clonic spasms which sometimes follow are, perhaps, free from danger, but are frightening to those unaccustomed to its use.

3. The rebreathing is objectionable for reasons stated before.

4. It is necessary to give a very strong ether vapor early to prevent a return of consciousness after the effects of the gas and rebreathing are gone. This sudden change to a strong administration of ether vapor often causes laryngeal spasm.

*Nitrous Oxide-Oxygen-Ether Sequence Method.*—This is also obtained by means of special apparatuses: Heidbrink's, Gwathmey's, Connell's, McKesson's, etc. No rebreathing is used. Anesthesia is begun by the administration of nitrous oxide mixed with oxygen in amounts varying from 5 to 15 per cent, according to the depth of the anesthesia, the type and condition of the patient. As soon as consciousness is lost ether, in gradually increasing amounts, is given with the gas and oxygen. When complete ether narcosis is obtained (three to five minutes) the gas and oxygen are discontinued and air substituted.

Advantages.—1. The nitrous oxide-oxygen-ether method has the advantage of abrogated induction period and the quick surgical anesthesia as has the nitrous oxide-ether method.

2. The oxygen mixed with the nitrous oxide prevents cyanosis, muscular rigidity, clonic spasms and other symptoms of asphyxia, without destroying the anesthetic property of the nitrous oxide.

3. By mixing oxygen in the proper proportions with nitrous oxide, complete narcosis can be maintained indefinitely and is used sufficiently long to permit complete ether narcosis to be established. Since the

nitrous oxide and oxygen are continued until complete etherization, there is then no return of the reflexes when air is substituted and consequently no swallowing of the ether-laden secretions. This prevention of swallowing eliminates a great factor in the production of postanesthetic nausea and vomiting.

4. This longer administration of nitrous oxide and oxygen permits of a gradually increasing and dilute administration of ether, which tends not to excite a hypersecretion of mucus. The patient is at no time overwhelmed with ether as with the gas-ether method.

5. Nitrous oxide-oxygen-ether apparatus provides for the use of oxygen with the ether if a condition arises which demands it. Oxygen administered with the ether will quickly stop a clonic spasm without decreasing the amount of ether being used. This cannot be done with air. Oxygen administered with ether gives a better narcosis and more perfect relaxation. It is often of decided advantage in patients of feeble vitality. The blood can safely take up much more ether if it is in a condition of hyperoxygenation.

6. The fact that no deaths have been reported from the use of this method speaks well for its safety.

Disadvantages.—1. The initial cost of these apparatuses is considerable. Its use is somewhat more expensive than the gas-ether or closed methods; it is considerably less, however, than the open method.

2. The portability of apparatus for this method is less convenient.

3. Considerable skill is necessary for its use.

In all cases where ether or chloroform or ethyl chloride are contraindicated gas-oxygen should always be the anesthetic of choice and administered with any of the apparatuses which are today provided for its administration. The improvement that has taken place in the apparatuses which are now on the market for the administration of gas-oxygen-ether in the form of analgesia or anesthesia is quite remarkable. It would be impossible to elaborate on the advantages and disadvantages of these different gas-oxygen machines as each anesthetist has his particular favorite machine.

McKesson, of Toledo, has assembled a machine which, apparently, is almost perfection. Pages could be written on the symptoms and signs of gas-oxygen anesthesia. McKesson has formulated a chart of light anesthesia due to too much oxygen in the mixture; normal anesthesia due to properly balanced mixture with nitrous oxide and oxygen; profound anesthesia due to too much nitrous oxide in the mixture, or to partial obstruction of the respiratory passages. In order to give McKesson full credit for this nitrous-oxide-oxygen sign chart I am taking the liberty of copying it *verbatim.*

**Light Anesthesia**—Due to too much oxygen in the mixture.

*Respiration*—

(a) Superficial slow breathing usually regular.
(b) Prolonged inspiration.
(c) Phonation due to reflexes or pain.
(d) Holding breath, grunting.

*Muscular Phenomena*—

(a) Movements or rigid muscles.
(b) Facial expression of pain or consciousness.
(c) Nausea, very rarely.
(d) Reflex or voluntary resistance.

*The Eye*—

(a) Pupils large, contract to light actively.
(b) Conjunctiva sensitive.
(c) Eyeballs roll.
(d) Eyelids resist opening, wink when touched.

*Color in Skin*—

(a) A pink or no change normally.
(b) In anemics no color change.
(c) In plethorics slight cyanosis.

*Remedy*—

Decrease the percentage of oxygen in the mixture.

**Normal Anesthesia**—

Due to properly balanced mixture of nitrous oxide and oxygen.

*Respiration*—

(a) Full "machinelike" respirations.
Regular and faster than normal.
(b) Inspiration and expiration nearly equal.
(c) No phonation.
(d) Continuous uninterrupted respiration.

*Muscular Phenomena*—

(a) Immobile and relaxed but having normal muscular tonus.
(b) Expression of normal sleep.
(c) Quiet.
(d) Quiet, relaxed.

*The Eye*—

(a) Pupils small or medium fixed.
(b) Conjunctiva insensitive to touch.
(c) Eyeballs fixed or slowly roll.
(d) Lids often slightly open, relaxed, no winking.

*Color in Skin*—

(a) Varies from pink to decided cyanotic tint.
(b) In anemics no color change.
(c) In plethorics considerable cyanosis.

**Profound Anesthesia**—

Due to too much nitrous oxide in the mixture or to partial obstruction of respiratory passages.

*Respiration*—

(a) Irregular rhythm (sobby) usually slower than normal. Spasmodic.
(b) Prolonged expiration.
(c) Phonation due to muscular spasm of muscles of exhalation.

*Muscular Phenomena*—

(a) Clonic movements, twitching or jerking in early minutes of induction, often start in upper eyelids.
(b) Expression wild looking.
(c) Swallowing, retching or vomiting.
(d) Tetanic spasm, marked rigidity, opisthotonus in some cases.

*The Eye*—

(a) Pupils fixed, enlarge progressively and finally become irregular in shape.
(b) Conjunctiva insensitive.
(c) Eyeballs fixed in some position or jerking.
(d) Eyelids stiff, often wide open.

*Color in Skin*—

(a) Usually cyanotic.
(b) In anemics slight flushing, rarely cyanotic.
(c) In plethorics almost black.

*Remedy*—

Increase oxygen in the mixture or inflate lungs with pure oxygen two or three times.

III. Chloroform.—Chloroform, $CHCl_3$ was discovered in 1831 and chemically described in 1835. In 1847 Simpson used it for the first time as an inhalation anesthetic. It is a colorless liquid, with an ethereal odor and taste. It is not inflammable. Chloroform may be made by the action of sodium hydroxide upon chloral hydrate. Like ether, it deteriorates on exposure to air and light and becomes more toxic to the patient. It is marketed in small amber bottles containing 25 gm., which is generally ample for one anesthetic.

The pupils in chloroform anesthesia behave in the same manner as they do in ether anesthesia, with the exception that pinpoint pupils are suggestive of lightness. In profound, but safe chloroform anesthesia, the globes are fixed, lustrous, the pupils slightly dilated and the light and corneal reflexes sluggish.

Respiration is not stimulated as much as in ether anesthesia, the rate generally being slower and the volume less. The rhythm must be preserved as its failure invariably precedes cardiac failure.

The effect upon the blood pressure is practically the same as in ether anesthesia; chloroform being a protoplasmic poison may effect the heart muscle, a lethal dose causing heart failure in a few minutes.

The pulse is one of the most valuable signs in chloroform anesthesia and its tension, size, and rapidity should be carefully watched. It is of far more importance than in ether anesthesia. Circulatory depression, of course, will give a rapid, thready pulse, accompanied by pallor.

Overdosage of chloroform may produce death either by paralysis of the respiratory center or by direct action upon the heart muscle. As a protoplasmic poison, chloroform may not produce a fatal issue for

days after the administration. Examination of the kidney and liver in chloroform poisoning shows many hemorrhages and fatty degeneration.

Chloroform should be administered drop by drop on a Schimmelbusch inhaler mask, with sufficient gauze on it to admit plenty of air, and the induction should always be accomplished with the patient in a slight Trendelenburg position.

*The Advantages of Chloroform.*—Chloroform is indispensable in spite of its drawbacks. Notwithstanding all that has been truly advanced against it, chloroform always has been, and probably it, or the mixture of it, will largely remain, the drug which the general practitioner most commonly uses for producing anesthesia.

The following advantages may be fairly claimed for it:

1. It is pleasant in smell and *seems* easy to administer. It produces little or no shock so that even children often inhale it without resistance.

2. No special apparatus is required to obtain the best results.

3. Smallness of quantity used.

4. Quiet anesthesia.

5. Chloroform is noninflammable.

*Disadvantages of Chloroform.*—1. The high rate of mortality among patients put under its influence. One out of every one thousand persons succumbs.

2. It appears to possess what may be almost termed selective action on the circulatory apparatus.

3. Chloroform is essentially depressant to animal vitality, and is a protoplasmic poison.

4. Tendency to decompose and give off irritating and poisonous vapors in the presence of naked light.

IV. Ethyl Chloride.—Ethyl Chloride, $CH_3CH_2Cl$, was discovered by Florenz in 1847 and first used as an anesthetic at that time, although its use was not general until about 1900. It is a colorless, volatile liquid, possessed of an ethereal odor. It is made by distilling equal parts of hydrochloride acid and alcohol. It is marketed in special containers which have a spray attachment. Ethyl chloride is rarely used as a complete anesthetic on account of its narrow margin of safety. As an induction to ether, or for an incomplete anesthetic it is very toxic and possibly, excluding chloroform, is the most dangerous of all anesthetic agents.

Ethyl chloride has practically the same effect upon the eye reflexes as ether, but it should never be pushed to the point where the corneal reflex is lost or the pupil dilated. At the first sign of stertor in respira

tion the mask should be immediately removed. An overdose may act directly upon the heart muscle and produce death, or respiratory spasm may occur and death result from asphyxiation.

Ethyl chloride should be administered on an open mask with sufficient gauze to allow plenty of air, the patient being in a slight Trendelenburg position and being instructed to count along with the anesthetist. As soon as the patient stops counting surgical anesthesia will be complete.

*Conclusions.*—The drop ether method is practically safe, while its simplicity makes it the method of choice for the inexperienced. Its shortcomings of perfection have been noted and they are sufficiently important to demand consideration. Modern anesthesia has already reached the stage where refinements of methods are necessary, when skilled anesthetists are available. That a method possesses no serious obstacles is not enough. Modern surgeons and anesthetists demand a method of administering ether which overcomes certain minor and too often neglected objections, which are of more or less importance regarding the safety and pleasantness of ether anesthesia.

It may be ventured that hereafter general anesthesia will not be considered as a whole, but its various stages dealt with according to their obviously different requirements, and that this is to be accomplished by sequences of various anesthetics administered with an apparatus which is both accurate and practical, and by men whose entire time is given to this branch of the profession.

### 3. Drugs Which Affect the Circulation

**A. Drugs Which Affect the Heart.—**

DIGITALIS (Foxglove.) U.S.X. Preparations:

*Digitalis Folium.* U.S.X. Leaves of digitalis. Dose: see below.

*Tinctura Digitalis.* Tincture of digitalis. U.S.X. Dose: see below.

*Infusum Digitalis.* U.S.X. Dose: see below.

STROPHANTHUS. U.S.X. Preparations:

*Tinctura Strophanthus.* U.S.X. Dose: see below.

*Strophanthanin.* U.S.X. Dose: see below.

SCILLA. U.S.X. Preparations:

*Tinctura Scillae.* U.S.X. Dose: see below.

QUINIDINAE SULPHAS. U.S.X. Dose: 3 to 6 grains, or 0.2 to 0.4 gm.

EUPHYLLIN. Not official. Dose: 1½ grains or 0.1 gm.

Digitalis is one of the great drugs in therapeutics. Its action, especially within the last decade, has been subjected to the most painstaking examination. The literature that has been accumulated upon it is of voluminous proportions. Indeed there are men now living who have devoted most of their best years to its investigation. And it is worth noting that the work is so valuable because it has been clinical research, done not upon normal animals, but upon patients the subjects of the pathology the drug is designed to treat. Naturally I shall only be able to sketch in the merest outline the results of this research. Some statements that I make are open to controversial debate: when so, I shall try to indicate it. But the new science of digitalis should be opened to the general practitioner, and he should discard particularly the ideas of a decade ago, which are still retained in books on therapeutics about the physiologic action, the indications and particularly the dosage of digitalis.

Digitalis was introduced into medicine by William Withering, of Birmingham, England; his "Account of the Foxglove and Some of Its Medical Uses, with Practical Remarks on Dropsy and Other Diseases," appearing in print in 1785. It is well to go back and read again some of Withering's pages: we will find there, the origins of most of our problems in digitalis therapy. In the first place observe that it was designed as a remedy for dropsy. Withering tells us how he heard of an old woman in Shropshire who had brewed a tea, made of many herbs, which had a great reputation in cases of dropsy. He decided, when he obtained the recipe for it that the active ingredient was foxglove.

"I had not, however," wrote Withering, "introduced it into the more regular mode of prescription; but a circumstance happened which accelerated that event. My truly valuable and respectable friend Dr. Ash informed me that Dr. Carvley, then principal of Brazen Nose College, Oxford, had been cured of a hydrops pectoris, by an empirical exhibition of the root of the foxglove, after some of the first physicians of the age had declared that they could do no more for him. I was now determined to pursue my former ideas more vigorously than before, but was too well aware of the uncertainty which must attend on the exhibition of the *root* of a *biennial* plant and therefore continued to use the *leaves*. These I found to vary much as to dose, at different seasons of the year; but I expected, if gathered always in one condition of the plant, viz., when it was in its flowering state, and carefully dried, that the dose might be ascertained as exactly as that of any other medicine; nor have I been disappointed in this expectation. The more I saw of the great powers of this plant, the more it seemed necessary to bring the dose of it to the greatest possible accuracy. I suspected that this accuracy was not reconcilable with the use of a

*decoction,* as it depended not only upon the care of those who had the preparation of it, but it was easy to conceive from the analogy of another plant of the same natural order, the tobacco, that its active properties might be impaired by long boiling. The decoction was therefore discarded, and the *infusion* substituted in its place. After this I began to use the leaves in *powder* but I still very often prescribed the infusion.''

One of Withering's cases is as follows: ''July 25—Mrs. H. of A. near N. between forty and fifty years of age, a few weeks ago, after some previous indisposition, was attacked by a severe cold, shivering fit succeeded by fever; great pain in her left side, shortness of breath, perpetual cough, and after some days copious expectoration. On the fourth of June, Dr. Darwin was called to see her. I have not heard what was then done for her, but between the fifteenth of June and the twenty-fifth of July, the doctor, at his different visits, gave his various medicines of the deobstruent, tonic, antispasmodic, diuretic and evacuant kinds.

''On the twenty-fifth of July I was desired to meet Dr. Darwin at the lady's house. I found her nearly in a state of suffocation, her pulse extremely weak and irregular, her breath very short and laborious, her countenance sunk, her arms of a leaden color, clammy and cold. She could not lie down in bed and had neither strength nor appetite, but was extremely thirsty. Her stomach, legs and thighs were greatly swollen; her urine very small in quantity, not more than a spoonful at a time, and that very seldom. It had been proposed to scarify her legs, but the proposition was not acceded to.

''She had experienced no relief from any means that had been used, except from the ipecacuanha vomits; the dose of which had been gradually increased from 15 to 40 grains, but such was the insensible state of her stomach for the last few days, that even those very large doses failed to make her sick and consequently purge her. In this state of things I knew of nothing likely to avail us, except the digitalis; but this I hesitated to propose, from an apprehension that little could be expected from anything; that an unfavorable termination would tend to discredit a medicine which promised to be of great benefit to mankind, and I might be censured for a prescription which could not be countenanced by the experience of any other regular practitioner. But these considerations soon gave way to the desire to save the life of this valuable woman, and accordingly I proposed that the digitalis be tried; adding that I sometimes had found it to succeed when other, even the most judicious methods. had failed. Dr. Darwin very politely ac-

ceded immediately to my proposition, and as he had never seen it given, left the preparation and the dose to my direction. We therefore prescribed as follows:

℞ Fol. Digital. purp. recent. ℥iv
Aq. fontan. purae. lb.

℞ Decoct. Digital. ℥ ifs
Aq. Unc Maschat ℥ii M. fiat haust. 2 dis horis sumend.

"The patient took five of these draughts, which made her very sick, and acted very powerfully upon her kidneys, for within 24 hours she made upwards of eight quarts of water. The sense of fullness and oppression across her stomach was greatly diminished, her breath was eased, her pulse became more full and regular, and the swellings of her legs subsided.

"26th—Our patient being thus snatched from impending dissolution, Dr. Darwin proposed to give her a decoction of pareira brava, and guaiacum shavings, with pills of myrrh and white vitriol; and if costive, a pill with calomel and aloes. To these proportions I gave a ready assent.

"30th—This day Dr. Darwin saw her, and directed a continuation of the medicine as prescribed.

"August 1st—I found the patient perfectly free from every appearance of dropsy, her breath quite easy, her appetite much improved, but still very weak. Having some suspicion of a diseased liver I directed pills of soap rhubarb, tartar of vitriol, and calomel to be taken twice a day with neutral saline draught.

"9th—We visited our patient together and repeated the draughts directed on the 26th of July, with the addition of tincture of bark, and also ordered pills of aloe, guaiacum, and fol martis, to be taken if costive.

"September 10th—From this time the management of the case fell entirely under my direction, and perceiving symptoms of effusion going forwards, I desired that a solution of merc. subl. corr. might be given twice a day.

"19th—The increase of the dropsical symptoms now made it necessary to repeat the digitalis. The dried leaves were used in a fusion, and the water was presently evacuated as before.

"It is now almost nine years since the digitalis was first prescribed for this lady, and notwithstanding every preventive method I could devise, the dropsy still continues to recur at times; but is never allowed to increase so as to cause much distress, for she occasionally

takes the infusion and relieves herself whenever she chooses. Since the first exhibition of the medicine, very small doses have been always sufficient to promote the flow of urine."

Withering later describes the methods he pursued in order to determine the proper dosage of digitalis:

"The foxglove when given in very large and quickly repeated doses occasions sickness, vomiting, purging, giddiness, confused vision, objects appearing green and yellow; increased secretion of urine, with frequent motions to part with it; and sometimes inability to retain it; slow pulse, even as slow as 35 in a minute, cold sweats, convulsions, syncope, death.

"When given in less violent manner, it produces most of these effects in a lower degree; and it is curious to observe that the sickness, with a certain dose of medicine does not take place for many hours after its exhibition has been discontinued; that the flow of urine will often precede, sometimes accompany, frequently follow the sickness at the distance of some days, and not infrequently be checked by it. The sickness thus excited, is extremely different from that occasioned by any other medicine; it is peculiarly distressing to the patient; it ceases, it recurs again as violent as before; and thus it will continue to recur for three or four days, at distant and more distant intervals.

"But these sufferings are not at all necessary; they are the effects of our inexperience, and would in similar circumstances, more or less attend the exhibition of almost every active and powerful medicine we use.

"Perhaps the reader will better understand how it ought to be given, from the following detail of my own improvement, than from precepts peremptorily delivered, and their source veiled in obscurity.

"At first I thought it necessary *to bring on and continue the sickness in order to insure the diuretic effects.*

"I soon learned that the nausea being once excited it was unnecessary to repeat the medicine, as it was certain to recur frequently at intervals more or less distant.

"Therefore my patients were ordered to *persist until the nausea came on and then to stop.* But it soon appeared that the diuretic effects would often take place first, and sometimes be checked when the sickness or a purging supervened.

"The direction was therefore enlarged thus: Continue *the medicine until the urine flows, or sickness or purging takes place.*

"I found myself safe under this regulation for two or three years; but at length cases occurred in which the pulse would be retarded to an alarming degree, without any other preceding effect.

"The directions therefore required an additional attention to the state of the pulse, and it was moreover of consequence not to repeat the doses too quickly but to allow sufficient time for the effects of each to take place, as it was found possible to pour an injurious quantity of the medicine, before any of the signals for forebearance appeared.

"*Let the medicine therefore be given in the doses and at the intervals mentioned above; let it be continued until it either acts on the kidneys, the stomach, the pulse, or the bowels; let it be stopped upon the first appearance of any of these effects,* and I will maintain that the patient will not suffer from its exhibition, nor the practitioner be disappointed in any reasonable expectation."

Let us note these facts of Withering's account:

1. That digitalis was designed for use in dropsy, but that he frequently mentions the patient's rapid, delirious pulse.
2. That it was given until its pharmacologic effects were reached.
3. That it caused slowing of the pulse.
4. That when its action was at its height, the drug was withdrawn.

In other words, Withering tried to furnish some rough indices to the great problems of digitalis therapy—when to use digitalis, in what amounts, when to stop, what to expect, and how to determine the activity of any given sample.

For many years after Withering's death, the use of digitalis was neglected. When it was revived, the pharmacologists of that day concentrated their attention upon it as a heart tonic, and particularly supposed that it was valuable for loss of tone of the heart muscles. It was observed in the frog heart to cause an increase in the strength of the contraction, to prolong diastole, and to increase the nourishment of the heart. This action was shown by the work of Traube, Schmiedeberg and others to be due to the action of the drug upon the inhibitory center in the medulla.

Early in the first decade of the present century, new methods of study of the heart began to change many of our ideas. Dr. James MacKenzie, in his book on Diseases of the Heart, called attention to the use of tracings made simultaneously from drums on the jugular and the radial pulse. At a shortly later time Einthoven described the records made by the string galvanometer.

For a correct understanding of the action of digitalis, the work done upon the pulse irregularities with these two instruments paved the way. When tracings were made from all sorts of irregular hearts, it was found that there were three kinds of pulse irregularity which were immensely more frequent than all others. One was respiratory arrhythmia or sinoauricular arrhythmia, an increased rapidity of the pulse

during inspiration. The second was extrasystolic arrhythmia, the familiar "dropped beat." Neither of these has any clinical significance. The third was an irregularity which was named by Hering pulsus irregularus perpetuus, a poor name as the irregularity is not perpetual but comes and goes. "Absolutely irregular pulse" is a better name: it is a "delerium cordis." It is the irregularity of the incompensated heart of old valvular disease, less commonly of arteriosclerosis, of the incompensation of infectious diseases, and of many other conditions. It is usually the origin of the dyspnea, cyanosis and dropsy of cardiac failure.

It was in this last irregularity that digitalis was found to be most effective. The questions then arose: (1) What is the cause of this absolutely irregular pulse? and (2) How does digitalis effect relief? To both of these problems modern research has given a definite and complete reply.

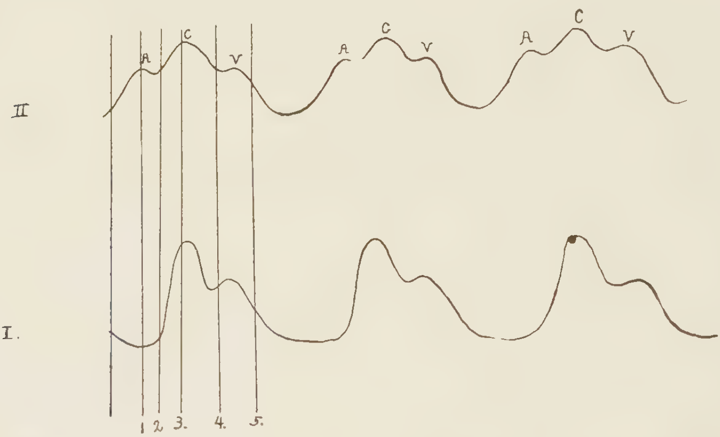



Fig. 8.—Tracing of normal venous and radial pulse—diagrammatic.

To answer the first question we must study the tracings made from the polygraph of a normal pulse, and from a case of absolutely irregular pulse.

In Fig. 8 there is represented a diagram copied from an actual tracing by the polygraph on a normal subject. I is the radial pulse; and II is the jugular pulse which gives us information as to the left auricle. The black lines transecting these tracings indicate various events in the cardiac cycle: *1* is the auricular systole; *2* is the beginning of ventricular systole; *3* is the carotid pulse; *4* is the end of systole; *5* is the opening of the tricuspid valves.

The transections of these lines indicate the same periods in point of time all along the line. By following *1* we can see what is occurring in jugular and radial pulse at the beginning of auricular systole.

Studying the jugular pulse alone we find that there exists first a rise in pressure (the "a" wave) due to the systole of the auricle, followed by a small wave labelled "c" which is due to the pulse of the carotid artery affecting the jugular tracing. There is then a fall in the tracings which occurs during ventricular systole and is due to the emptying of the fluid contents of the thorax. The wave "v" is due to the filling of the auricle during the ventricular systole, and the marked fall following "v" occurs with the opening of the auriculo-ventricular valves and marks the end of ventricular systole.

In absolutely irregular pulses, such as we have referred to above as being the accompaniment of heart failure, the tracings show in the radial pulse that no two beats are alike either in strength as indicated by the height of the wave, or length of the wave. The wave in the radial pulse corresponds exactly to a large wave in the jugular pulse, representing the carotid pulse, or "c." But there is no "a" wave. In order to explain this, Mackenzie elaborated an ingenious theory.

"In a normal venous curve," to quote Lewis, "each upstroke of the carotid is preceded by a prominent wave known to result from auricular systole (a). This wave is missing whenever the pulse shows the characteristic irregularity." Moreover he showed that it vanishes when the irregularity suddenly appears in a patient whose pulse has previously been regular. Another fact was elicited by the same worker. He noticed in a case of mitral stenosis that, when a presystolic murmur had been present, this murmur was lost when the pulse became disorderly. He rightly attributed the original murmur to auricular systole, and explained the two phenomena, namely, the absence of auricular pulsation in the neck and the absence of auricular murmur in the chest, by supposing a change in the action of the auricle. The actual change postulated was paralysis of the auricle. But Mackenzie on continuing his researches, found not only that with the restoration of the regular rhythm the auricular wave is restored but that in cases which succumb without such restoration, the right auricle may show considerable hypertrophy. These facts ultimately led him to the rejection of his first hypothesis. Believing that an hypertrophied auricle could not remain inactive, and holding abrupt paralysis and abrupt renewal of the auricular systole to be improbable, he sought a new explanation and concluded that auricle and ventricle contract together; for under these circumstances the evidences of the auricular contraction would be buried in the ventricular systole. But simultaneous contraction of the auricle and ventricle required explanation; and Mackenzie, influenced by certain histological findings, expressed the view that auricle and ventricle com-

mence their contractions in the tissue which lies between them and unites them, namely, the upper end or "node" of the auriculo-ventricular bundle. Here is the origin of the term "nodal rhythm."

This irregularity stands described then as nodal rhythm in the second edition of Mackenzie's "Diseases of the Heart" (1910). There was far, however, from a whole-hearted acceptance of this theory of nodal rhythm by other workers; it did not explain first the efficacy of digitalis in this condition, and it did not explain why the pulse was irregular as there was no reason why the impulses originating at the auriculo-ventricular node should not be initiated as regularly as at the sino-auricular node.

In 1906, Cushny and Edmonds suggested that certain forms of paroxysmal tachycardia in man showed similar arterial tracings to the arterial

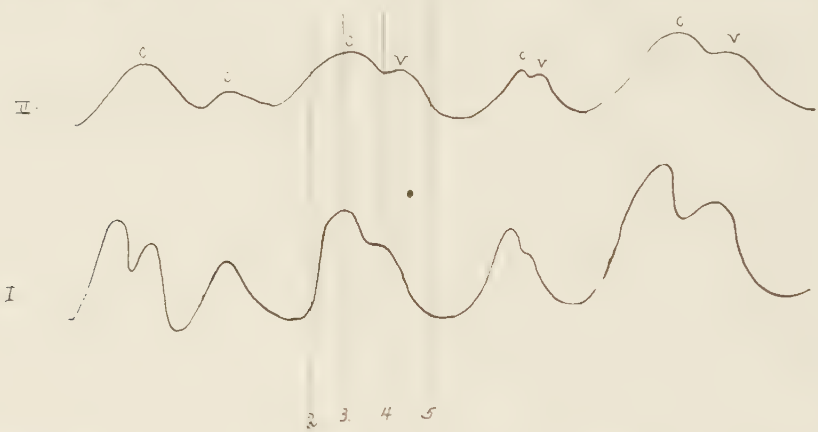



Fig. 9.—Tracing of venous and radial pulse in auricular fibrillation—diagrammatic.

tracings of dogs in which a condition of fibrillation of the auricle had been induced by repeated electric shocks. When these tracings were shown to Dr. Mackenzie he was struck with the fact that the tracings from cases of "nodal rhythm" were exactly similar.

The auricular fibrillation induced in dogs and other experimental animals is a condition that has long been known to physiologists. The appearance of the auricle in this condition "is very characteristic," but it is "difficult to picture it unless it has been seen; instead of the short shock contraction which is characteristic of the normal auricular movement, one sees a quivering surface, each fiber of which seems to act independently of the others. A somewhat similar quivering is sometimes seen in the tongue and may be more familiar to you. During fibrillation the auricle ceases to expel its blood and dilates widely. Impulses continue to pass from the auricle to the ventricle as fast as they

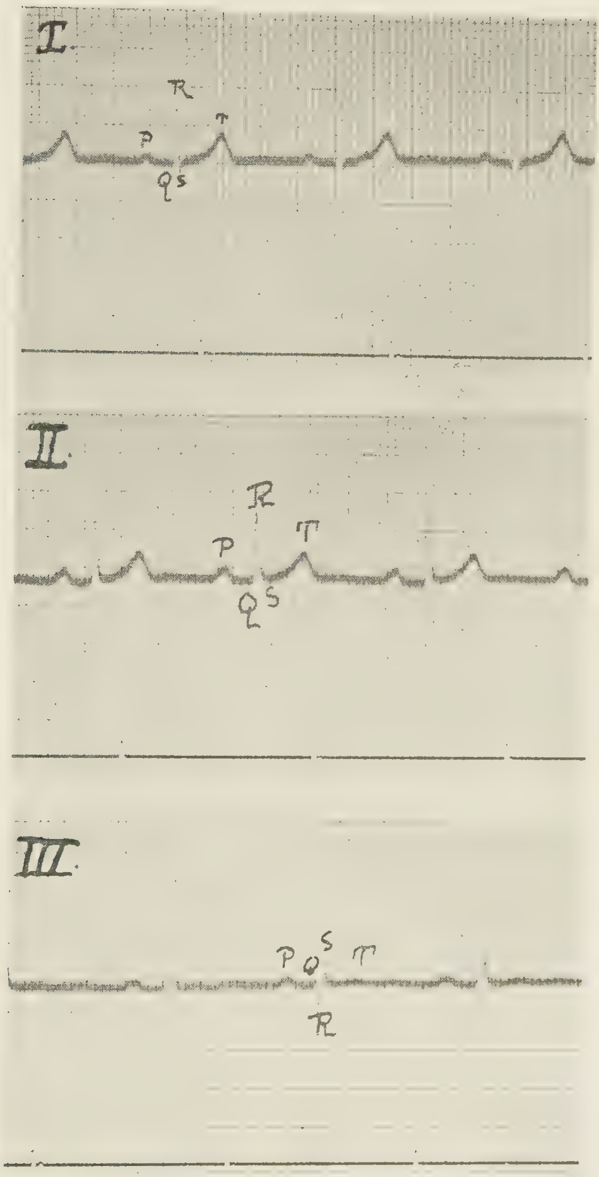



Fig. 10.—Normal electrocardiogram. Three leads are usually taken. The vertical lines are time marks representing .2 of a second.

*P*, the wave of auricular contraction; *Q, R, S, T*, the waves of ventricular contraction.

can be transmitted through the connecting band of His'' (Cushny) so that the ventricle is constantly bombarded with impulses and contracts only to those which it is in a position to receive, that is, during its period of receptivity after rest. These times must necessarily be irregular, hence the irregularity of the pulse.

The final proof that this irregularity is due to fibrillation of the auricles was furnished by the electrocardiograph.

A normal electrocardiogram is made in three leads, from various arm and leg electrodes, and shows five waves, three positive and two nega-

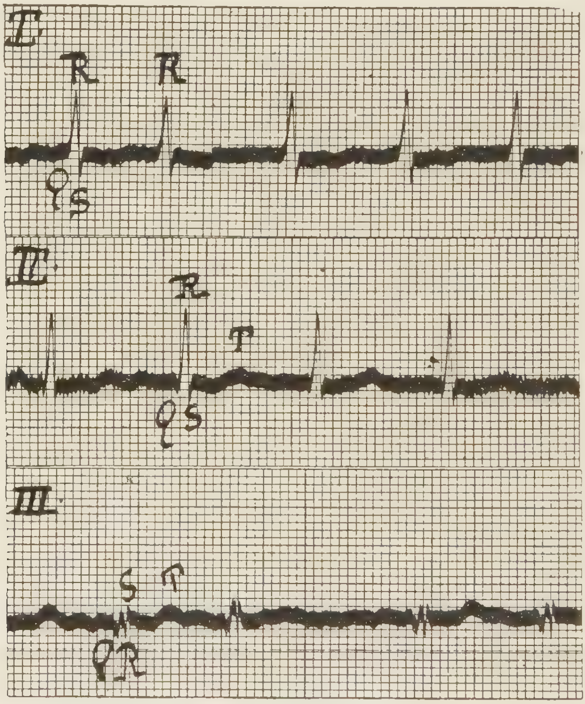



Fig. 11.—Electrocardiogram of auricular fibrillation. Note disappearance of *P* wave.

tive. These have been labelled P. Q. R. S. T. ''P'' is due to the contraction of the auricle, the remainder being due to variations of potential during the rest of the cardiac cycle. In an electrocardiogram taken from a patient with auricular fibrillation the ''P'' wave is gone and a series of fine waves takes its place.

How does digitalis effect relief in cases of auricular fibrillation, and of auricular flutter? Cushny was, I believe, the first to suggest that it did so by causing a partial heart block. The auricle being in fibrillation, and impulses being carried along the bundle of His in such great

numbers, a block or paralysis of this conducting bundle, would allow the ventricle to begin to beat upon its own rhythm. This is the commonly accepted explanation of the action of digitalis.

For practical purposes, there are several questions concerning digitalis which we must ask when about to use it:

1. What are the indications for the use of digitalis?
2. What are the contraindications for digitalis?
3. How can the practitioner be assured of the activity of the sample he is about to use?
4. What preparations should be used?
5. What is the dosage of digitalis?
6. How often should the dose be repeated?
7. When shall the administration of digitalis be stopped?

1. Indications for digitalis:

*Auricular fibrillation* is, of course, the primary indication for the use of digitalis. The drug has been called the specific for auricular fibrillation. The question arises as to how the physician who is denied the use of cardiograph and electrocardiograph tracings is to determine whether or not fibrillation is present. This is quite possible, in the majority of instances, provided one familiarizes himself with the nature of the disturbance. The most valuable result of all the exact mechanical researches on the pulse has been to teach the physician their existence, to enable him to pick them out and differentiate them by palpating the pulse. He may make mistakes, sometimes, but then so do the instruments. It is well to remember that irregular rapid pulse, edema, and dyspnea nearly always mean auricular fibrillation and call for digitalis. In a patient with a rapid irregular heart, a pulse deficit (a difference between the beats of the heart and the pulse rate) is a good sign of auricular fibrillation.

Should digitalis be given in heart conditions other than those in which auricular fibrillation is present? Many general practitioners have been trained in the thought that digitalis is the drug to use in *any* form of heart disease, or heart symptoms. This reliance on what is unctuously called "the sheet anchor" results in many disappointments. There are certain classes of patients with evidences of cardiac failure, who do not have auricular fibrillation—some cases of failure in valvular disease, some in arteriosclerosis, in febrile conditions, in the rapid pulse of tuberculosis and Graves disease. Cohn has carefully considered this

problem and has classified all patients, who might be subjects for digitalis, under the following groups:

| | | |
|---|---|---|
| 1. Normal rhythm | a. Without edema— | 1. With normal blood pressure. |
| | | 2. With high blood pressure. |
| | b. With edema— | 1. With normal blood pressure. |
| | | 2. With high blood pressure. |
| 2. Auricular fibrillation | a. Without edema— | 1. With normal blood pressure. |
| | | 2. With high blood pressure. |
| | b. With edema— | 1. With normal blood pressure. |
| | | 2. With high blood pressure. |

The first groups include paroxysmal tachycardia, exophthalmic goiter, tachycardia, rapid but regular pulse in pneumonias and other febrile conditions. Cohn observed patients in each group under the administration of digitalis and concludes that digitalis is ineffective in simple rapid pulse—paroxysmal tachycardia, etc. This is certainly borne out in clinical experience. In the absence of edema Cohn observed no diuretic effect. In pneumonia, he believes it is of prophylactic value.

Granting, however, that auricular fibrillation is the prime indication for its use, and granting also that it will not, *per se*, slow a rapid rate, its use in obvious slight cardiac failure of tone should not be discouraged. With a regular rapid pulse, some dyspnea on exertion, occasional symptoms of palpitation, a little crepitation at the base of the lung, digitalis should be administered. In any combination of these symptoms, in any one alone, it should be given.

Gottleib and Magnus demonstrated on the isolated perfused heart, that digitalis causes an increase in the volume output of the ventricles at every beat, both by lengthening the diastole, and increasing the force of ventricular systole. If this is true for the human heart, during life, and we have no reason for supposing otherwise, digitalis must be of some value in these conditions of lack of tone.

2. Contraindications:

*Heart block* is the only absolute contraindication for the use of digitalis. Heart block may, in general, be recognized by the slow pulse. And here we have again the translation into physiologic language, of a clinical fact that was long known—that digitalis should not be given in the presence of a slow pulse. As we have seen, digitalis *causes* heart block: therefore it would only augment such a condition. Yet I have seen patients with all the symptoms of Stokes-Adams disease who were being given digitalis simply because they had fainting attacks: the reasoning in the mind of their physician probably ran: "Fainting attacks equal heart disease, heart disease equals digitalis."

The possibility of heart block occurring in contagious diseases is not to be forgotten. *Diphtheria* indeed has a special tendency to cause heart block, and digitalis should never be given to strengthen the heart in diphtheria, except for the very best of well-defined reasons, established by instrumental methods.

It was once the habit of clinicians to state that *aortic insufficiency* offered a contraindication to the use of digitalis. This was based upon theoretical grounds, the reasoning being that digitalis prolongs diastole

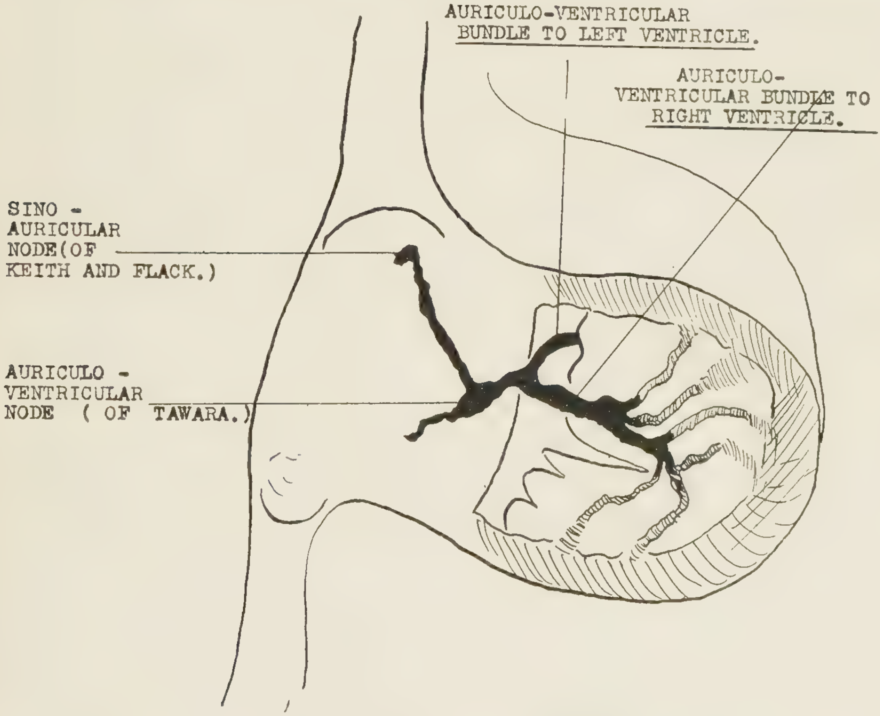



Fig. 12.—Diagram of the anatomy of the neuromuscular bundle of His.

and that a prolonged diastole in aortic insufficiency offers serious impediment to the mechanical effectiveness of the heart in maintaining the circulation. The reasoning was perfectly logical, but the conclusions, tested in the fire of experience, are valueless. Aortic insufficiency itself offers no contraindication for the use of digitalis. If a heart with aortic insufficiency goes into fibrillation, or loses tone, digitalis will be indicated just as in any other valvular defect.

*High blood pressure* is another condition which has been put down as a contraindication for digitalis. The matter has been subjected to the most painstaking investigation by many experts (Eggleston, Cohn,

Mackenzie, Price, and Lawrence) and with a unanimity unusual among experts, they have stated that digitalis even in very large therapeutic doses does not affect the blood pressure in any way. Eggleston showed that "the vasoconstriction which could be demonstrated to occur in animals, and in isolated surviving vessels under the influence of digitalis took place only when amounts of the drug were used, which were far in excess of any which could possibly be given to man." He records the following table of average changes in blood pressure following the administration of digitalis, measured upon 14 patients, some with normal, some with low and some with high pressure.

| | ALL CASES | NORMAL PRESSURE CASES | HIGH PRESSURE CASES |
|---|---|---|---|
| *Systolic Pressure:* | | | |
| Before Digitalis | 156 | 124 | 191 |
| After Digitalis | 156 | 127 | 193 |
| Percentage of change | 0 | plus 2.4% | plus 1% |
| *Diastolic Pressure:* | | | |
| Before Digitalis | 95 | 73 | 118 |
| After Digitalis | 86 | 64 | 110 |
| Percentage of change | –9.5% | –12% | –7% |
| *Pulse Pressure:* | | | |
| Before Digitalis | 62 | 51 | 73 |
| After Digitalis | 73 | 63 | 83 |
| Percentage of change | plus 18 | plus 23 | plus 14 |

We may conclude, therefore, that high blood pressure is not a contraindication to its use and that digitalis does not affect the blood pressure markedly in any way.

3. How can the practitioner be assured of the activity of the sample he is about to use?

Digitalis might be used as a text, for a sermon, upon two therapeutic platitudes. One is that, for success in drug therapy, we must be sure we are using an active preparation. (The other is be sure to give enough to result in physiologic change.)

For digitalis, there has been worked out a satisfactory method of measurement of activity by biological assay, that is, by testing the effect of the drug upon a living animal. It must be evident that this will give a far more reliable measurement of activity than the mere weight of the drug.

Hatcher has described what is now known as the cat method, the unit being the weight of the dry drug in milligrams which is required to kill 1 kg. of cat when a solution is injected slowly and intravenously. This amount is called a cat unit. For reasons which are given in the original paper, it was found more practical to inject first a measured amount of the digitalis body for about ten minutes and then after an interval of twenty minutes substitute a solution of crystalline ouabain

until the death of the animal. The following example of the method is furnished: "A tincture representing 70 mg. of digitalis per kg. of cat was injected into the femoral vein and after twenty minutes the injection of a solution of ouabain was begun. The animal died with the typical symptoms of digitalis poisoning when 0.0142 mg. of the crystalline ouabain per kg. had been injected. The difference between 0.0142 mg. and 0.1 mg. (which would have been required had the ouabain been used alone) is 0.0858 or 85.8 per cent of a cat unit, hence 70 mg. of digitalis equals 85.8 per cent of a cat unit and 81.6 mg. of the digitalis represents one cat unit." The original article should be consulted for details.

The frog method of assay measures the minimal amount of the drug required to arrest the frog's heart in systole in one hour. Healthy frogs weighing 15 to 25 grams are used. Each frog receives an injection, the amounts being calculated so that a series is formed of which the lowest dose will be about half, and the highest about twice the fatal one. The frogs are killed at the end of an hour and the heart is exposed. The highest doses will have arrested the ventricle in complete systole, the lowest will not have affected it at all. Somewhere in the series is the minimal dose which has arrested the ventricle in systole. This dose is injected into another series of frogs, and the results recorded.

No preparation of digitalis should be used by the practitioner unless he has assured himself of its activity, or unless the firm putting it on the market gives authentic evidences of having subjected it to one or the other method. Other things being equal, the cat method is the better.

4. What preparations of digitalis should be used? This is a most important consideration. The market is so flooded with preparations, that the practitioner may well be confused. *It may be stated, however, that there are only two preparations of digitalis which the practitioner should use under ordinary circumstances: Both are official—The tincture and the dry leaf.* These represent the most constant active preparations of the drug.

The infusion is a watery solution of the drug leaves, but must be made freshly and depends, for its potency, upon the state of the compounding pharmacist's supply of leaves. If one can be assured of their quality the infusion is valuable. It should be given in doses of 2 to 4 drams every 6 hours.

Of the other unofficial preparations of the drug a brief notice will be given.

The hypodermic use of the drug, using such preparations as *digitalein*, and *digatoxin* is entirely unwarranted. Digitalis is not a good drug to use hypodermically. If rapid digitalis-like action is desired strophanthanin should be used intravenously. "*Digalen* is a solution of impure

digitalein from the leaves.'' It is ''a very weak preparation and has no advantage over the ordinary tincture'' (Cushny). *Digipuratum,* now called *digitan,* is a preparation of the glucosides from the leaves, and freed from inactive constituents. It is a good preparation, but is not superior to an active powdered leaf. *Digifoline,* according to the manufacturers, is a preparation of all the glucosides of digitalis leaf in natural proportions. It is not the powdered leaf, but a crystalline product. No report of the cat method of assay with this preparation is available, and in clinical practice it is in no way superior to the official preparations.

The tincture, made by a reliable firm, remains the best routine preparation. It is more stable than the infusion, and it has been found, that if kept in an air-tight bottle, it will stay potent for at least a year. A tincture, kept in a corked bottle, with the cork removed every few days, deteriorates in about six months. A large corked bottle on a druggist's shelves, therefore, is not likely to remain active. Those drug firms, which put up tinctures in one ounce, air-tight bottles, are likely to offer a better tincture than any other. Personally the writer has had good results with the tincture put up by H. K. Mulford & Co., under the trade name of ''Digitol,'' the tincture of Squibb & Co., and the tincture of Upsher Smith.

Mackenzie states that he has never found an inactive tincture. But this is in England. The foxglove grows well in the climate of England. In the United States, a different species found to be active is grown in Minnesota. This plant is marketed by Upsher Smith and offered to the profession in the form of the tincture and the dried leaf in capsules. So many inferior preparations are on the market, and the importance of obtaining an active preparation is so great, that I feel justified in stating that these preparations have always shown the highest degree of efficiency in my hands. It is marketed so that 10 minims of the tincture and 1 grain of the powdered leaf represent one cat unit.

The use of the powdered leaf for long-continued administration is to be highly recommended. For a long time I was theoretically prejudiced against the powder because I supposed that it would not be absorbed or utilized as fully as a liquid preparation. This, however, is entirely wrong. Grain for grain it seems to be quite as efficient as the tincture. Christian prefers the powdered leaf to all other preparations. For a patient who must continue the use of digitalis over long periods of time while at moderate activity, the powder has obvious advantages over any liquid preparation: it can be carried about without the danger of spilling and it occupies less space. It is generally advised that the leaf be powdered just before use.

5. What is the dosage of digitalis? The official dose of the tincture, as set down in the tenth revision of the Pharmacopoeia is 15 minims; for the powdered leaf it is 1½ grains. These doses are for clinical purposes entirely too low. The complete effect of the drug cannot be reached at this dosage for many days, if ever. Cary Eggleston has put out a method of digitalis dosage, which has come to be known as the Eggleston method. Using Hatcher's standard of digitalis activity by the cat method, Eggleston proposed that the average total amount of digitalis required for oral administration to man is 0.15 of one cat unit per pound of body weight of the patient.

Eggleston's formulae are:

$$\text{I. } \frac{\text{C. U.} \times 0.15 \times \text{W}}{1{,}000} = \text{Grams of powdered leaf in total amount.}$$

$$\text{II. } \frac{\text{C. U.} \times 0.15 \times \text{W}}{100} = \text{c.c. of tincture in total amount.}$$

$$\text{III. } \frac{\text{C. U.}}{100} \times \text{W} = \text{c.c. of infusion in total amount.}$$

C. U. = Cat unit in milligrams of prescription.
W. = patient's weight in pounds.

An illustrative formula is as follows:

The digitalis available has an activity of 100 mg. to the cat unit. The patient weighs 150 pounds.

$$\frac{100 \times 0.15 \times 150}{100} = 22.5 \text{ c.c. of the tincture as the total dose.}$$

This same formula works out for 2.25 grams of the powdered leaf, and 150 c.c. of the infusion for the same patient.

Eggleston, in 1922, advised a modification of his calculations, so that the dosage now recommended is 0.1 cat unit per pound of body weight of patient. This is very simple to calculate, as many tinctures are of the strength of 1 cat unit to 10 minims of the tincture; if such be the case with your preparation, then one minim is given for each pound of body weight. (Remember that a minim is not the same as a drop from an ordinary dropper, but nearly twice as much: the dosage should be accurately measured.) Assuming the relative strength of tincture and powdered leaf given above, the dosage for a patient of 150 pounds would be 150 minims of the tincture and 15 grains of the powdered leaf.

Eggleston gives the following rules for the administration of digitalis:

"Administration of average calculated total amount:

"1. When the Patient Has Received No Digitalis Within the Preceding Ten Days.

"A. In Urgent Cases.—From one-third to one-half of the total calculated amount is administered at the first dose. After an interval of six hours, from one-fifth to one-fourth of the total is administered. After a second six hours, from one-eighth to one-sixth of the total is administered. Thereafter, if more digitalis is needed, about one-tenth of the total may be repeated every six hours until maximal digitalization is secured.

"B. Rapid, for Nonurgent Cases.—About one-fourth of the calculated total is to be given at each of the first two doses, six hours apart. Thereafter about one-tenth to one-eighth of the total is given every six hours.

"**2. When the Patient Has Been Taking Digitalis Within the Preceding Ten Days.**

"Before further digitalis is prescribed, the patient is to be subjected to the most careful examination, including the use of polygraphic or electrocardiographic records if available, to determine whether or not there are any evidences of digitalis action.

"A. When Evidences of Digitalis Action Are Absent.—The procedure is the same as outlined above, except that the total amount of digitalis required is to be reduced to 75 per cent of the total calculated.

"B. When Evidences of Partial Digitalization Are Present.—

"It is best not to attempt to administer more than one-half of the total calculated amount of digitalis, divided equally between the first three doses. In urgent cases in this group, however, one may administer 75 per cent of the calculated amount, preferably in three equal doses, and then if digitalization is not quite complete, one-tenth of the total amount may be prescribed every six hours.

"Safeguards:

"The appearance of one or more of the following criteria of adequate digitalization, or of minor digitalis intoxication, indicates the cessation of further administration, either permanently or temporarily:

"1. Nausea or vomiting (except when due to splanchnic congestion and present before treatment is begun).

"2. Fall of heart rate (not pulse rate) to or below 60 a minute.

"3. Appearance of frequent premature contractions; of definite heart block; of marked phasic arrhythmia, or of coupled rhythm.

"The observance of a six hour interval between doses allows time for complete absorption of the preceding dose and the development of

its full action on the heart so that if the patient is examined just before the administration of each dose, dangerous intoxication can be absolutely prevented. In practice it is perfectly safe to give the first three doses without personally examining the patient before the second and third doses if the one nursing the patient is properly instructed to look for nausea, vomiting, or slowing of the pulse to 60 or less a minute before giving the succeeding dose, and to stop administration if any of these phenomena appear.

"When a leaf tincture, or infusion, the cat unit of which is unknown is employed, 100 mg. may be taken as the cat unit; but not more than 75 per cent of the calculated total amount should be given in the first three doses.

"When the patient cannot be weighed, or when marked edema or general anasarca is present, the body weight (exclusive of edema fluid) must be estimated as closely as possible and the total amount of digitalis calculated as usual. Not more than 75 per cent of the calculated amount should then be given in the first three doses."

6. How often should the dose be repeated? Robinson by careful experiments, has dispelled the older ideas that it requires many hours or days for digitalis to exert its action when given by mouth. He found that in auricular fibrillation or flutter large single doses of the tincture began to affect the heart in from two to five hours after oral administration. The maximum effect is usually obtained in about twenty-four hours, and continues to be effectual for from four to fifteen days.

This last statement probably accounts for the so-called cumulative effect of digitalis. The persistence of its action makes digitalis of particular value as a cardiac remedy. It seems to be "due to the firm fixation of a small amount of the drug in the tissue of the heart, where it continues to exert its action." This demonstrates that it is unnecessary to give digitalis at short intervals, never more often than every four hours, and generally every six hours. When it is planned to keep a patient on digitalis for some time it need only be given once a day.

Pardee has worked out the elimination rate of the tincture of digitalis by digitalizing patients, then letting them rest for a certain number of days and determining how much tincture of digitalis is required to redigitalize them. The amount of digitalis used divided by the number of days which elapsed gave the elimination rate per day. He found, on the average, that the body disposes of 22 minims per day. Individuals

varied considerably in this, however, as some excreted as low as 10 minims and others as high as 40 minims.

7. When shall the administration of digitalis be stopped? Where instrumental methods are available, the inversion of the T-wave of the electrocardiogram may be taken as the indication of the full physiologic activity of the drug. The prolongation of the A-C interval on the cardiograph has the same significance.

A marked grade of sinus arrhythmia, heart-block, premature contractions, and coupled rhythm are all evidences of full or slightly toxic digitalis action.

If the practitioner has not instrumental methods available he may still be able to measure his digitalis action roughly. In the first place the pulse is slowed, and made regular provided the drug has been used in the rapid, irregular pulse of auricular fibrillation. Nausea is an important symptom to watch. Upon its appearance the drug should be stopped. A marked increase in the amount of urine shows that the drug is acting. And finally improvement in physical signs is an indication either for withdrawal, or for a reduction in the dosage.

*Summary of Rules for the Administration of Digitalis.*—We have tried to show, in the above paragraphs, that modern research has laid a firm foundation to guide us in the indications for digitalis, the dosage to give, how frequently to repeat it, and when to stop it. The presentation of the evidence may make it seem somewhat confusing. We will therefore summarize these questions here as simply as possible.

1. Indications: Heart failure.

(1) Auricular fibrillation—rapid, irregular pulse with or without edema, cyanosis, dyspnea, liver enlargement and pulmonary congestion.

(2) Auricular flutter.

(3) Loss of cardiac tone—evidenced by breathlessness on exertion, or slight edema, or rapid pulse, or attacks of palpitation, or any combination of these.

(4) During the course of pneumonia and other infections as a prophylactic against cardiac failure.

"The indication for the administration of digitalis is determined by the degree of heart failure, not by the cause of the failure" (Eggleston).

2. Contraindications:

(1) Heart block—evidenced by slow pulse and fainting attacks.

(2) During or after diphtheria.

High blood pressure and aortic regurgitation are *not* contraindications.

3. Method of Administration:

*Calculation of Dosage.*—Adopting the Eggleston standard of 0.1 cat unit per pound of body weight and assuming that we have preparations of about 1 cat unit to 10 minims of the tincture and 1 grain of the powdered leaf the calculation of dosage is simple: point off the patient's weight in decimals. Example: the patient weighs 149 pounds: the dose of the tincture is 149 minims; the dose of the powdered leaf is 14.9 grains.

*Calculation of Elimination.*—When the tincture is given, the 22 minims which are eliminated per day must be deducted.

Example of calculation: The patient weighs 150 pounds. The dosage of the tincture used is 150 minims. It is given in doses of 20 minims each four times a day.

| | | | |
|---|---|---|---|
| 1st Day—Total amount given | 80 | minims | |
| Deduct elimination | 22 | " | |
| | 58 | " | —Total dose first day |
| 2nd Day—Total dose | 80 | minims | |
| Add 1st day utilized amount | 58 | " | |
| | 138 | " | |
| Deduct elimination | 22 | " | |
| Total utilized | 116 | " | —Total dose for two days |
| 3rd Day—Amount required to complete dosage | 34 | minims | |
| Add for elimination | 22 | " | |
| | 56 | " | |
| Dosage for third day | 56 | minims | |
| Add second day's utilized amount | 116 | " | |
| | 172 | " | |
| Deduct elimination | 22 | " | |
| | 150 | " | |

Digitalization should be complete.

Using these calculations, digitalization can be accomplished in either 1, 2, 3, 4, or 5 days.

In actual practice, however, few experienced clinicians go through such exact calculations. It is necessary for them to understand the principles and experiments upon which these calculations are based, because if one held to the dosage of digitalis as given in the pharmacopoeia few patients would ever receive the benefits of digitalis therapy. It is evident, however, from these researches, that no exact dosage can be determined for any new patient because the entire calculation may be upset by having a patient with a high rate of elimination.

*The only sensible way then to exhibit digitalis is to return to the method of Withering and, given a patient who is a proper subject for digitalis, to administer digitalis until the favorable result is obtained, then to maintain a sufficient dosage to keep the patient in comfortable equilibrium.*

The exactly proper cases for digitalis therapy are patients with auricular fibrillation; that is, heart failure with irregular pulse, dyspnea and dropsy. In these it acts as a physiologic specific. In no other condition can we say that certain effects are obtained by its use. Fortunately for its usefulness these cases of fibrillation constitute about 60 per cent of heart failures. They are largely divided between the patients with mitral stenosis and the patients with arteriosclerotic heart. Digitalis is given such a patient after the onset of fibrillation until the pulse is slowed and regular, or, if complete regularity cannot be obtained, and usually it cannot, until a sufficient number of strong heart beats come through per minute to clear up the dropsy and shortness of breath. Usually the large initial doses will cause nausea and other signs of slight digitalis poisoning. When this occurs, the drug can be withheld for a few days until the symptoms pass and then a smaller daily dose recommenced. This *maintenance dose* may have to be continued for years. It will be on the average, 22 minims of the tincture daily, calculating by Pardee's figures. However, as we have seen, there is a wide variation in the elimination rate of different individuals. So in practice we have to find the daily dosage by trial. It is safe to start out on 15 drops (not minims) three times a day after the initial digitalization is complete and, if the pulse is kept strong (not necessarily regular) and symptoms in abeyance with no nausea, that dose may be maintained. If not, the dose is raised or lowered. Few cases of mitral stenosis once it is begun cease fibrillating. In some, however, and more of the arteriosclerotic cases of fibrillation, quinidine administration after digitalization may cause cessation of the fibrillation. It is always worth trying. But most hearts with mitral stenosis, once the auricle begins to fibrillate, must remain under the influence of digitalis until death supervenes. Many such patients take digitalis daily for years.

*Other Members of the Digitalis Group.*—

*Strophanthus* has an action similar to digitalis. It is much more active than digitalis, but cannot be depended upon for therapeutic use, because of the irregularity of its absorption. Usually the absorption rate is low, yet at times it has been absorbed so rapidly as to cause poisoning.

The principal use of strophanthus is in the form of the active principle strophanthanin, used intravenously. This gives a very rapid digitalis-like action. Strophanthanin represents the active elements in

strophanthus, no similar preparation being known for digitalis. For rapid "digitalization," $\frac{1}{100}$ grain of crystalline strophanthanin intravenously is most effective. A word of warning should be given. Certain solutions of strophanthanin on the market will cause most alarming symptoms—convulsions, etc. I have found the strophanthanin put up by Burroughs, Wellcome & Co., without these effects, and it is the only form I can recommend.

*Squill*, also a member of the digitalis group, is a drug which has been much used since before the days of Hippocrates. It was formerly used for its diuretic effects. It acts like digitalis, inverting the T-wave of the electrocardiogram, and causing heart block. As with digitalis, the official dosage is far too small, drams ii to iv (8 to 16 c.c.) of the tincture being required. These facts have recently been carefully verified by White and his associates.

*Quinidine Sulphate* is used in auricular fibrillation and for extrasystoles to restore regular rhythm. It is obtained from cinchona bark as a by-product of the manufacture of quinine. Like quinine it is a general protoplasmic poison. Its action on the heart muscle is depressant. It increases the refractory period of the auricular muscle, and increases the conduction time in the auricles. In this way it corrects auricular fibrillation and restores normal cardiac rhythm. There are some dangers to its use by producing ventricular tachycardia going on to ventricular fibrillation; it may act on the respiratory center in overdoses causing paralysis. Embolic accidents have occurred under its exhibition. There appears to be a distinct idiosyncrasy to it in susceptible individuals; therefore a small preliminary dosage is always advisable. Caffeine is the best antidote.

In auricular fibrillation restoration to normal rhythm occurs in about half the cases in which quinidine is employed. It is more regular in its beneficial action in the fibrillation occurring in arteriosclerotic hearts than in mitral stenosis. Digitalis should be administered before quinidine is given, until digitalization is complete or well under way and the signs of congestive failure have disappeared. Under these circumstances quinidine may restore the normal rhythm. When it accomplishes this, its use should be discontinued for a period; if irregularity again supervenes, its exhibition may be recommenced.

Extrasystoles usually disappear under its use. Smith has used it in paroxysmal tachycardia.

Dosage.—Quinidine may cause toxic symptoms in some patients, with nausea, vomiting, convulsions, palpitations, and headache. The initial dose is 3 grains (0.2 gm.). If no untoward results occur, regular administration of 3 to 6 grains (0.2 to 0.4 gm.) three to four times a day is begun the day following the initial dose. I have given as much as 15

grains four times a day. The change to normal rhythm may be looked for in from one to three days.

*Euphyllin* (now called metaphyllin) is indicated in the heart failure which is dependent on a deficient coronary circulation. Its main pharmacologic action seems to be to increase the blood flow through the coronaries. This increases the nutrition of the heart muscle and thus restores functional efficiency of the heart. It can be administered regularly to a patient with angina; its exhibition is also indicated when pain is not occurring. It may prevent anginal attacks by restoring a more even coronary circulation. Its action is much like theophyllin (in fact its activity probably is due to its theophyllin content) and diuretin. It is put up in tablets of 1½ grains each. The dosage may be three to six of these a day.

**B. Drugs Which Affect the Vessels.—**

1. By Raising Blood Pressure.—

*Caffeina*—U.S.X. (For description see page 160.)

*Camphora*—U.S.X. Preparations as:

*Camphor Gum*—Dose: 1½ grains or 0.10 gram.

*Aqua Camphorae*—U.S.X. A very weak solution of camphor in distilled water. Dose: 2½ drams contain ½ grain camphor.

*Spiritus Camphorae*—U.S.X. Dose: 15 minims or 1 c.c.

*Linimentum Camphorae*—U.S.X. (camphorated oil). Camphor in cottonseed oil. Should not be used for hypodermic injection. One hundred c.c. equals 20 grams camphor.

*Epinephrin*—(adrenalin) not official. Dose: 5-15 minims or 0.3 to 1 c.c.

*Ergota*—U.S.X. Preparations:

*Fluidextractum Ergotae*—U.S.X. Dose: 30 minims or 2 c.c.

Active principles—Ergotin, cornutal, eruntin, etc., made by various manufacturers.

Ephedrine Sulphate—Not official.

The conditions under which we wish to stimulate the elevation of blood pressure are shock, and the heart failure of acute infections, a condition physiologically much like shock. The treatment of these conditions is not very hopeful. And the drug treatment is by no means the most successful form of it. For details of the complete treatment see page 633.

In the pharmacologic laboratory, upon otherwise healthy, and artificially shocked animals, epinephrin, caffeine and to a less extent camphor and ergot cause a steady and favorable rise in pressure. In actual practice they nearly always fail. Possibly this is because the shock induced in the pharmacologic laboratory is a mechanical shock, and

purely mechanical shock is seldom encountered in the hospital, the shock there being toxic, usually due to infection, and the infection keeps adding continuously to the shock and undoing all the good the vasoconstricting drugs accomplish.

The most active of the preparations listed above is unquestionably epinephrin. No other drug has one-tenth its power and certainty of causing a rise of arterial blood pressure. Its effect seems to be a direct one on the vessels and their intrinsic nerves, for it occurs after destruction of the vasomotor center. Its effect unfortunately is transient, the effect being prompt, but lasting only about five minutes. Certain facts about its administration are not generally understood. It is used in medicine for several purposes, one being in shock, one as an antispasmodic in asthma, one as an accompaniment of cocaine for local anesthesia. For raising blood pressure it is of no value unless given intravenously. Intramuscularly is practically intravenously, as the network of small veins in a muscle take up solutions almost as a vein does. For use in allergic or anaphylactic conditions it is possible to administer it by dropping it on the tongue and allowing it to absorb there. It is better to administer it intramuscularly in these conditions, but on the tongue will do. Hypodermic use of epinephrin is of less value under most conditions. As to dosage, 15 minims (1 c.c.) of a 1 to 1000 solution is the dose for raising blood pressure in a 150 pound patient. The dose should be often repeated and may be increased.

Neither camphor nor caffeine has a marked effect upon blood pressure in the laboratory, and little change can be observed after their administration in clinical practice. Their effect upon the tone of the heart is more evident. Both exert their effect longer than does adrenalin. In pneumonia each has been extensively recommended. Caffeine certainly seems to do more good than camphor. It may be given by mouth, or hypodermically, or in the form of hot black coffee by rectum. Its general effect upon the nervous system may be more important than any direct circulatory action. The dose should be large, 3 to 5 grains hypodermically.

Camphor is generally given hypodermically, dissolved in olive oil. It is not without permanent localized ill effects, as has been shown by Mook and Wander, who reported "camphorated oil tumors" in the skin of patients who had received these injections. They are not unlike paraffinomas, the tumors resulting from the injection of paraffine subcutaneously for cosmetic purposes. That these tumors are more than mere unabsorbed camphor and oil may be understood when Mook and Wander state that one of them submitted to a pathologist was pronounced tuberculous on account of its granulomatous character. Camphor has been extensively used in pneumonia, not only on account of its action on the

circulation, but also because it was once supposed to be a specific for the pneumococcus toxin. Few clinicians who have used it extensively would be willing to state that it has great value.

2. By Lowering Blood Pressure.—

*Amylis Nitris*—U.S.X. Preparation: as amyl nitrite, a clear yellowish liquid easily volatilized and usually used by inhalation. Dose: 3 minims or 0.2 c.c. by inhalation.

*Sodii Nitris*—U.S.X. Dose: 1 grain or 0.06 gram in solution.

*Spiritus Glycerylis Nitratis*—U.S.X. *Spirits of Glonoin. Spirits of Nitroglycerine.* Dose: 1 minim or 0.05 c.c.

*Tablets of Nitroglycerine*—Not official. Dose: $\frac{1}{100}$ grain or 0.0006 gram.

Potassi iodium—U.S.X. Dose: see below.

*Euphylline*—Not official. Chemically, Theophylline-Ethylenediamine. Dose: 1-3 grains (0.06-0.2 grams).

*Potassium Sulphocyanate*—Not official. Dose: 1½ grains (0.1 gm.) to 5 grains (0.3 gm.).

The nitrites lower blood pressure rapidly and for a short time. The type drug of the series is amyl nitrite; every student of medicine should demonstrate its action upon his own person. The inhalation of the fumes from a broken nitrite pearl causes, with the utmost regularity in 100 per cent of human beings, a flush of the cheeks, an easily discernible dilatation of all the vessels of the face and neck, a rapid pulse rate, and an enormous fall in both systolic and diastolic blood pressure. This action is not central in origin, as the same effects will not occur if the drug is perfused through the medulla without reaching the vessels, but is due to direct action upon the arterioles and venules. The dilatation of these vessels occurs all over the body, the coronary arteries, be it noted, sharing in it. Another point is of some importance: stimulation of a constrictor nerve will cause a rise in pressure, even in the midst of nitrite action. This is worth noting because occasionally in angina pectoris, the exhibition of amyl nitrite will not serve entirely to abate the attack or stop the pain. We know little of what causes attacks of angina, and it may be that a too strong constrictor influence is being exerted, during those attacks in which the amyl is not beneficial.

The effect of the inhalation of amyl nitrite passes off in a few minutes, and for this reason it is only of value during the actual attack of angina pectoris. The use of the nitrites in general is pretty closely confined to the treatment of angina. Sodium nitrite and nitroglycerine are usually taken by mouth, and best taken so; their action lasts longer than amyl nitrite, and is quite as effective. In general it may be said, that if an individual is only occasionally attacked with angina, amyl nitrite

pearls are the best to use, but, if he is subject to recurrent attacks all day long for several days on end, he should take sodium nitrite or nitroglycerin every 4 to 6 hours, for the days which experience teaches him the attacks will last.

For continued regular use in anginal states, euphyllin is probably the best drug.

For the treatment of high blood pressure over a long period of time, drugs are probably not the best form of treatment. Potassium sulphocyanate prescribed in an aqueous solution so that 1 fluidrachm (4 c.c.) contains 1½ grains (0.1 gm.) of the salt may be given three times a day. Euphyllin, diuretin, and theophyllin may also be employed in this connection.

**C. Drugs Which Influence Edema.—**

*Calcii Chloridum.* U.S.X. Calcium Chloride. Dose: see below.

*Ammonii Chloridum.* U.S.X. Ammonium Chloride. Dose: For dropsy 75 to 150 grains (5 to 10 grams).

*Novasurol.* Not official. Dose: 8 to 15 minims (0.5 to 1.0 c.c.) of a 10% solution. Intramuscularly or intravenously.

Edema, particularly that due to nephritis and nephrosis, can perhaps best be treated by the exhibition of calcium chloride or ammonium chloride with or without novasurol. Kieth and Rowntree have popularized their use in this country. In 1911 Meyer and Cohn found that calcium chloride added to infants' food caused a decrease in weight, apparently by loss of water. Schultz, using these observations in the treatment of war nephritis, found that 10 gm. of calcium chloride caused a prompt disappearance of edema after other methods had failed. The disappearance of the edema was accompanied by diuresis. Blum confirmed these observations and found that the loss of water was accompanied and probably caused by the output of large amounts of sodium. As the retention of sodium salts is known to accompany or cause fluid accumulation in the body, and as the sodium in these cases left the body in the form of sodium chloride, it has been supposed that it is the chlorine ion which is the important element in the action of the drug, and as ammonium chloride acts just as well, this supposition seems to be justified. Calcium chloride and ammonium chloride are both acid salts and produce an acidosis in the body. When they are administered, there is a fall of the alveolar carbon dioxide, and an increased excretion of the sodium, ammonium and total acids of the urine with a reduction in its hydrogen-ion concentration. Calcium chloride after ingestion is split up, the calcium being excreted by the bowel as calcium carbonate, the chlorine being absorbed into the blood as hydrochloric acid which produces acidosis. The consequent diuresis is probably due to "the acidity whereby the

blood and tissue proteins are brought near the iso-electric point, releasing cations held in Donnan equilibrium, diminishing osmotic pressure, and causing loss of water."

Ammonium chloride acts as well as calcium chloride so far as producing the diuresis and consequent loss of edema is concerned, and it has the advantage that in doses sufficient to accomplish this it does not upset the stomach. Calcium chloride frequently causes nausea and vomiting. To obtain the best results, the ammonium chloride is administered along with novasurol. The amount of ammonium chloride given depends upon the patient's weight (including the edema) and how much the patient's stomach will tolerate. From 75 grains (5.0 gm.) to 150 grains (10.0 gm.) per day in divided doses may be given. Novasurol in doses of 8 minims (0.5 c.c.) to 15 minims (1.0 c.c.) may be used to reenforce this. A diet low in salt and water should also accompany the drug treatment. Keith mentions three diets: Diet 1 contains 1400 c.c. of water and 5 gm. of extra salt, with 40 gm. of protein. Diet 2 contains 1400 c.c. of water and no extra salt, being a salt-free nephritis diet. Diet 3 contains 800 c.c. of water and only 0.5 gm. of sodium, 1.76 gm. of potassium, etc. In certain cases of brawny generalized edema the diet alone did little, the diet and ammonium chloride did little, but the diet, the ammonium chloride and the novasurol caused a prompt disappearance of the edema.

Novasurol is a double salt of sodium mercurichlorphenyl oxyacetate with diethylbarbituric acid. It has diuretic properties and relieves dropsy when given alone. It contains 33.9 per cent of mercury. It is soluble in water and is usually put up in 10 per cent solution. It is administered either intramuscularly or intravenously in doses up to 2 c.c.

This combination of drugs, ammonium chloride and novasurol, is useful in every kind of edema. In the edema of cardiac failure due to auricular fibrillation digitalis is, of course, the drug of selection. But in the dropsy of heart failure with regular pulse, ammonium chloride and novasurol are of splendid service. They are a very important addition to our therapeutic armamentarium in this field. In cirrhosis of the liver with ascites no other drugs work so well. In nephritis with dropsy they often relieve the dropsy promptly.

### 4. Drugs Which Affect the Blood

1. Iron: Preparations:

   *Ferri carbonas*—U.S.X. Ferrous carbonate—$FeCO_3$. Usually prescribed in the form of Massa ferri carbonatis—Vallet's mass. Dose: 4 grains or 0.25 gram, or Pilulae ferri carbonatis—Blaud's pills—each pill containing 1 grain or 0.06 gram $FeCO_3$. Dose: 1, 2, or 3 pills.

   *Tinctura ferri chloridi*—U.S.X. Tincture of ferric chloride. Tincture of iron. Dose: 8 minims or 0.5 c.c.

*Tinctura ferri citro-chloridum*—N.F.V. Tasteless tincture of iron. Dose: 8 minims or 0.5 c.c.

*Ferri Phosphas*—U.S.X. Usually prescribed in the form of Syrupus Ferri, Quininae et Strychninae Phosphatum—N.F. (Syrup of the phosphates of iron, quinine and strychnine). Dose: 1 dram or 4 c.c.

*Ferri sulphas*—U.S.X. Dose: 1½ grains or 0.1 gram.

*Ferrum reductum*—U.S.X. Dose: 1 grain or 0.6 gram.

In 1747, Menghis demonstrated iron in the blood of man. Even before that it was customary to prescribe iron in conditions of anemia and weakness, and the custom has continued unabated to the present day. The underlying idea was simple—to supply a necessary element of blood. Experimental evidence has not, however, tended to support the practice. Bunge's famous theory was that inorganic iron is not absorbed from the alimentary tract, and that its presence simply allowed the organic iron in food to be more readily absorbed. He recommended, on this basis, the prescribing of organic iron compounds, iron albuminate, etc. He later retracted his main contention—that inorganic iron was not absorbed—and his theory appears now only in the literature of manufacturers of organic iron compounds.

Lately the controversy has shifted and the researches of Whipple, Hooper and Robscheit contend that in the form of anemia for which iron is usually prescribed—secondary anemias following hemorrhage,—inorganic iron in the form of Blaud's pill is of no effect on the regeneration of blood, the animal obtaining sufficient iron from the diet. They found no better results from organic iron or from arsenic. Musser endeavored to duplicate, in dogs, the conditions most frequently seen in clinical practice—anemia due to repeated small losses of blood—and concluded that even here the regeneration occurred so rapidly that the influences of the iron could not be demonstrated.

In spite of these experiments it is a safe venture that iron will continue to be used in clinical practice. No experiment has shaken the ground for the use of iron in chlorosis. In this condition the iron in food does not bring about good results until some iron salt is given by mouth. In other anemias we still lack carefully controlled clinical experimentation in human patients made ill, not by artificial means, but by disease. We have no series of cases for instance of women who have menorrhagia and their hemoglobin curve with and without the administration of iron.

The administration has some difficulties. It is extremely important to be sure the preparation used is assimilable. Blaud's pills, for instance, on standing become hard and insoluble and pass through the

intestine unchanged. A preparation named Liquid Blaud has seemed to be, for that reason, the best form in which to prescribe ferrous carbonate.

In chlorosis the older clinicians used the sulphate of iron in doses of one to three grains in capsule three times a day.

2. Arsenic: Preparations—

*Liquor Potassii arsenitis*—U.S.X. Fowler's solution. Dose: 3 minims or 0.2 c.c.

*Sodii cacodylas*—U.S.X. Sodium cacodylate. Dose: 1 grain or 0.06 gram.

Arsenic is used as a general tonic, as a nerve stimulant, and for its stimulating effect on the skin. No very good experimental background exists either for or against its use. Arsphenamine is used for pernicious anemia and other conditions besides syphilis for its general tonic effect. Patients do feel better and sprightlier after its use, there is no question of that, although it is a little difficult to evaluate these feelings. Sodium cacodylate hypodermically has in some cases a marvellous temporary effect upon inoperable cancer. It was once heralded as a cancer cure, which, of course, it is not.

3. Benzol—Not official.

A preparation is made by Merck called Crystallizable Benzene, medicinal. Dose: 8 to 15 minims or 0.5 to 1 c.c. in capsules (four times a day for leukemia).

In order to study the formation of the different types of cells in the bone marrow in adults, pathologists, notably Bunting and Selling, who were particularly interested in the problem, found that injection or oral administration of benzol to animals would cause a degeneration of the marrow. It could in fact be rendered nearly cell free, and then, as regeneration occurred, the formation of the new cells studied. It was soon suggested that the use of benzol could be extended to the treatment of those diseases in which the bone marrow is in a condition of too great functional activity. It was first used in leukemia and later in erythrocythemia. In leukemia it never effects a cure, but at that is as effective as any other method of treatment In erythrocythemia it is more effective so far as permanent results go than in leukemia, although it has been used on too few cases to allow of any crystallized opinions.

While it is being administered the physician should examine the blood carefully, at frequent intervals, in order not to carry the administration to the point where complete obliteration of the marrow occurs.

It is possible that the substances in benzol which cause marrow degeneration, are impurities and that when the pure form of the drug is used,

the reduction in leucocytosis does not occur. This may be at times the cause of failure in its use in leukemia.

4. PHENYLHYDRAZINE HYDROCHLORIDE.—Not official.
Dose: 5 grains (0.3 gm.) daily.

Phenylhydrazine hydrochloride was first used for the treatment of polycythemia vera in 1918 by Eppinger and Klass. The drug was originally used in experimental studies on animals for the production of anemia. The reduction of red corpuscles under its use is very rapid. It is thought not to cause any general bodily damage, though it is well known that liver injury can be produced experimentally by its use. The dose is five grains (0.3 gm.) per day by mouth. Usually by the time 80 grains (5.0 grams) have been given or a treatment period of from two weeks to twenty days, the blood cells will be so reduced that its administration must be stopped.

**Drugs Which May Cause Coagulation of the Blood.—**

*Calcium lactas*—U.S.X. Dose: 8 grains or 0.5 gram.

*Horse serum*—Dose: 10 to 50 c.c.

*Thromboplastin*—(Most forms of this preparation are made from brain substance.) Dosage varies with the different preparations.

Transfusion—See page 433.

*Morphine*—q. v.

The coagulation of the blood, while the explanation of it is by no means definitely settled, is supposed to occur by reason of the following actions and reactions: (In order to discuss the use of substances which promote clotting they will be stated quite dogmatically. For a discussion of the various views the reader is referred to any book on physiology.)

The clotting of blood is caused by the formation of fibrin.

Fibrin does not exist as such in the blood. It does exist as fibrinogen, which is formed in the liver.

Fibrinogen is turned into fibrin by the action of thrombin.

Thrombin does not exist as such in the blood, but as thrombogen or prothrombin.

Prothrombin acted on by calcium and some other substance is turned into thrombin.

The other substance, which has been named thromboplastin is perhaps formed from tissue juices or disintegrated leucocytes or disintegrated blood platelets. It is known that after blood is drawn the blood platelets immediately begin to dissolve. Perhaps the reason blood does not clot in the vessels is by reason of a body called antithrombin which the dissolved platelets (or thromboplastin) may neutralize.

To summarize:

Antithrombin is neutralized by thromboplastin.
This liberates prothrombin.
Prothrombin + calcium = thrombin.
Thrombin + fibrinogen = fibrin.

It is clear then what was theoretically in mind when calcium, horse serum and thromboplastin were suggested. In most clinical conditions of hemorrhage internally these substances are entirely ineffective, because in most clinical conditions of hemorrhage the hemorrhage continues not on account of the inability of the blood to coagulate but on account of an open artery—for instance, in hemorrhage after tonsillectomy, in hemorrhage from a gastric ulcer, in hemorrhage from a typhoid ulcer, in hemorrhage from the lungs in tuberculosis. In these conditions the use of morphine is far more efficacious than any other method of treatment.

In the hemorrhagic diseases in which there is a real deficiency of some coagulating element in the blood, coagulants should be more effective—hemophilia, purpura, scurvy, etc. But these conditions are rare. The conditions in which lack of calcium is a factor are scurvy, rickets, and infantile scurvy. In hemophilia thromboplastin and horse serum are indicated. In purpura and hemorrhage of the newborn the hemorrhages are due to lack of platelets and transfusion or thromboplastin is indicated.

Transfusion as a matter of fact by supplying platelets is probably the best treatment we have for most of these conditions.

It has been found that the substance, thromboplastin, is contained in large amounts in the brain and the commercial products are largely brain extracts. It is found in even larger amounts in lung substance, but commercially this has not yet been used.

## 5. Drugs Which Affect the Digestive System

### 1. Drugs Which Are Used for Their Effect Upon the Stomach.—

A. To Allay Nausea or Vomiting:

The alkalies—see below.
The emetics in small doses—see below.
Chloroform. See page 78.
Chloral hydrate. See page 71.
Menthol. See page 149.
Chloretone. Not official. Dose 5 grains or 0.3 gram.
Calomel. See page 140.
Codeine. See page 66.
Morphine. See page 66.

*Sodii chloridum.*—U.S.X. Common salt. Dose: 50 c.c. of a 2 per cent solution.

*Cerii oxalas*—U.S.IX. Cerium oxalate. Dose: 3 grains or 0.2 gram.

B. To Induce Vomiting:

*Apomorphinae Hydrochloricum*—U.S.X. Dose: Hypodermically 1/12 grain or 0.005 gram. By mouth 1/6 grain or 0.01 gram.

*Ipecacuanha.* See page 56.

*Antimonii et potassii tartras.* See page 150.

C. To Neutralize Acidity or Lessen Secretion:

*Sodii bicarbonas*—U.S.X. Sodium bicarbonate, baking soda. Dose: 3 grains or 0.2 gram.

*Calcii carbonas precipitatus*—U.S.X. Calcium carbonate, precipitated chalk. Dose: 15 grains or 1 gram.

*Magnesii oxidum*—U.S.X. Light calcined magnesia. See page 133.

*Magnesii oxidum ponderosum*—U.S.X. Heavy magnesia. Dose: 30 grains or 2 gram.

*Bismuthi subcarbonas*—U.S.X. Dose: 8 grains or 0.5 gram.

*Bismuthi subgallas*—U.S.X. (Dermatol.) Dose: 8 grains or 0.5 gram.

*Bismuthi subnitras*—U.S.X. Dose: 8 grains or 0.5 gram.

*Extractum Fellis Bovis*—U.S.X. Powdered ox gall. Dose: 1½ grains or 0.1 gram.

*Belladonna*—See page 73.

D. To Furnish Digestive Secretions:

*Acidum hydrochloricum dilutum*—U.S.X. (10 per cent of HCl by weight.) Dose: 15 minims or 1 c.c.

*Pepsinum*—U.S.X. Dose: 8 grains or 0.5 gram.

E. To Increase the Flow of Gastric Juice:

*Alcohol*—U.S.X. Preparations: Wine, gin, whisky, etc.

*Gentiana*—U.S.X. Preparations:

- *Extractum gentianae*—U.S.X. Dose: 4 grains or 0.25 gram.
- *Tinctura gentianae Co.*—U.S.X. Dose: 1 dram or 4 c.c.

*Nux Vomica*—U.S.X. Preparations:

- *Extractum nucis vomicae*—U.S.X. Dose: ¼ grain or 0.015 gram.
- *Tinctura nucis vomicae*—U.S.X. Dose: 8 minims or 0.5 c.c.

*Cinchona*—U.S.X. Preparations:

- *Extractum Cinchonae*—U.S.X. Dose: 4 grains or 0.25 gram.
- *Tinctura Cinchonae*—U.S.X. Dose: 1 dram or 4 c.c.

F. For Pain in Ulceration:

*Argenti nitras*—U.S.X.

Vomiting is a means of treatment in itself—one of Nature's defensive reactions. If treatment for either nausea or vomiting is indicated, it depends upon the cause. If one wishes to have his therapeutic powers tested to the utmost, let him try to allay such a case as the nausea of seasickness. The drugs which are used act either on the centers in the brain or on the nerve-endings in the stomach. Of the former class, the following drugs, in the following dosages have been recommended:

| DRUG | DOSAGE GRAINS OR MINIMS | GRAMS OR C.C. | HOW OFTEN REPEATED |
|---|---|---|---|
| Amyl nitrite | ½ – 1 | 0.012 – 0.06 | p. r. n. |
| Nitroglycerin | ½ – 1 | 0.012 – 0.06 | p. r. n. |
| Chloral hydrate | 1 – 5 | 0.06 – .3 | ev. 6 hrs. |
| Cocaine | ⅙ – ½ | 0.003 – 0.012 | ev. 4 hrs. |
| Cannabis Indica | ¼ – 1 | 0.015 – 0.06 | ev. 8 hrs. |

For local action, chloroform, five or six drops on a piece of sugar; and various local anesthetics—orthoform—new, 7 grains (0.5 gram), anesthesin, 5 grains (0.3 gram), chloretone, 5 grains (0.3 gram) apothesine, 5 grains (0.3 gram) may have to be used. Champagne, beer or carbonated water are probably the most reliable agents of all.

Cerium oxalate was once extensively used. Baehr and Wessler report that if administered in advance it checks the vomiting from a local stomach irritant, but has no influence in stopping the vomiting from a centrally acting emetic as apomorphine. They recommended very much larger doses than are usually employed. They found it non-poisonous to dogs in doses of 50 grains.

The alkalies may be used if it is believed that the nausea is due to an excess of gastric juice. Small doses of the emetics, tartar emetic and ipecac, as Eustace Smith points out, may act as gastric sedatives.

Lehman and Gibson (Jour. Am. Med. Assn., April 25, 1925, lxxxiv, No. 17) recommend the use of a 2 per cent solution of sodium chloride in cases of nausea and vomiting. They tried it first in cases of partial intestinal obstruction with vomiting from reverse peristalsis, and later in the nausea and vomiting of pregnancy, in postoperative cases, in nausea in a case of duodenal ulcer, in globus hystericus, in car sickness, in cholecystitis and other varied cases. From 50 c.c. to 200 c.c. are given of the 2 per cent solution, at a temperature which feels cool to the patient's mouth.

B. *To induce vomiting*, whenever it is believed that a drug method of accomplishing this has advantages over the mechanical method of stomach washing, we have several reliable medicines. Apomorphine is chief among these. In cases of poisoning it is often of great value. Its action is central, upon the vomiting center in the medulla, as it acts even better by hypodermic use than by mouth. It induces profuse salivation, bronchial secretion and lachrymation, prostration and weak-

ness, although there is, so far as I have been able to find, no fatal case from its use on record. By hypodermic it should be given in doses of $\frac{1}{12}$ of a grain.

Other emetics are largely now in disuse. In other days they were the foremost remedies of the profession. It is a pathetic speech attributed to Dr. Nathaniel Chapman that at least if all his other writings perished, his chapter on emetics would last.

C. *To neutralize acidity* in the stomach we have soda bicarbonate, calcium carbonate, magnesium oxide, and for similar effects, the bismuth salts. Of these soda bicarbonate is probably the most effective. It has been stated that its use in hyperacidity is harmful because after it neutralizes the acid gastric juice, it stimulates the stomach to the secretion of more acid. So good a pharmacologist as Cushny, however, rejects this idea, and states that the alkalies have no influence on the gastric secretion. Certainly in clinical practice they act effectively.

In dosage soda bicarbonate can be used in quite large amounts over long periods of time—as much as two to four ounces a day for several weeks. It is to be remembered, however, that alkalosis, through its use, can occur. This is often evidenced by edema and nausea, etc. Its use therefore cannot be continued indefinitely, and Sippy advises in his ulcer cure, that the alkalies be stopped every five or six weeks for several days.

Soda bicarbonate has, of course, other uses in medicine than its local one on the stomach. In the condition of acidosis it is largely employed, whether it be the acidosis of diabetes or the acidosis of children's gastrointestinal diseases.

Calcium carbonate is insoluble in water and may be given in even larger doses than the bicarbonate of soda. It does not nearly so readily cause alkalosis, but is not quite so effective in neutralization of acid.

Magnesium oxide is also insoluble, and cannot be given in too large doses on account of its cathartic effects. It is a mild saline laxative. When it is combined with other alkalies and given for its neutralizing effects, the patient may complain of diarrhea. If he does the blame must attach to the magnesium oxide.

Bismuth, in one or another form of its various salts, has been used long and extensively in medicine as a gastric sedative. Combined with sodium bicarbonate it has gained a fame among the laity as bismuth and soda. It was once supposed that its action in gastric ulcer was to coat over the surface of the ulcer and protect it from further erosion, but our experience with it in x-ray work, in which it was extensively used for a time to outline the stomach and intestines, shows that it

leaves the stomach quickly and completely, and even in ulcer cases, leaves no traces behind. Its beneficial action seems to come, then, from its astringent effect, as it is also valuable in diarrheas.

It can be given by mouth in large dosage, but applied to raw surfaces as it sometimes is, bismuth poisoning is possible. The most striking symptom is a black discoloration of the edges of the gums, similar to the lead line of lead poisoning. Swelling of the tongue and throat, difficulty in swallowing, salivation, vomiting and diarrhea, and albuminuria may also occur.

Some controversy has arisen as to the best salt of bismuth to use. The controversy is largely confined to clinicians. The subgallate of bismuth, according to one school, is more effective both in ulcer and diarrhea than the other salts, because it has the additional astringent action of the gallic salt. The subgallate is a fine yellowish powder. The subnitrate has been given preference by some, because it liberates minute traces of nitric acid which traces are supposed to be efficacious in aiding in the healing of the ulcer. By others, on the contrary, the subcarbonate is recommended for the very reason that the combination of the subnitrate with an alkali is injudicious because of the liberation of acid. In actual trial these theoretical considerations seem to me of little value. All those named are insoluble and no bismuth salt should be used by mouth which is soluble.

In dosage, any of them may be given by mouth, as high as 20 grains three times a day, although the subgallate is recommended in smaller amounts. But, of course, when bismuth was used in x-ray work, before it was replaced by barium, it was used in much larger doses than that.

The use of ox gall in hyperacidity has been especially recommended by Palfrey. His theory of its action is based upon our knowledge of the physiology of the pyloric sphincter. The pylorus opens when the reaction is acid on its gastric side and alkaline or neutral on its duodenal side. The signal for the first opening of the pylorus is the appearance of free acidity on the stomach side. When this occurs, the pylorus opens and a jet of acid chyme enters the duodenum. The presence of acid in the duodenum causes the pylorus to close quickly, and it remains so until the acid in the duodenum is neutralized, when, if there is still free acid on the gastric side, the pylorus again opens and the process is repeated. The high acid content of the gastric juice in hyperacidity and ulcer would cause a delay in the neutralization of the jets of chyme in the duodenum, and would possibly delay the emptying of the stomach. This retention of food in the stomach may be the cause of some of the dyspeptic symptoms of hyperacidity. Ox gall by stimulating the flow of bile—it is the only true cholagogue—would provide a

means of neutralizing the acid gastric contents more rapidly. On this theoretical basis, Palfrey uses ox gall in hyperacidity and ulcer. I can confirm good results from its use in mild cases. I have used the preparation known as glycotauro made by Hynson, Westcott and Dunning. (Some mental reservations might be held as to the validity of the theoretical reasoning outlined above. The body has an enormous power to compensate functional defects. If more acid were thrown into the duodenum it probably would stimulate the liver to secrete more bile at any rate.)

Belladonna or atropine, is often used in hypersecretion of gastric juice, for its well-known action in reducing secretion. Bastedo has recently attacked its use on the ground that it is inert. After experimental work in human beings, testing the secretory course by the fractional method of gastric analysis, and the motor response with the x-ray, he concluded that (1) in the ordinary hyperacidity case with cessation of secretion at the usual time, atropine or belladonna in maximum doses, either by mouth or hypodermic, has no useful effect on acidity or secretion. (2) In cases of continuous hypersecretion it may check the secretion after the digestive period but in massive doses only. (3) In pylorospasm it may be useful but in maximum doses only, and (4) in the doses usually employed it is wholly without effect on the secretory or motor functions of the stomach.

These conclusions of Bastedo's have been attacked by Bennett, who working on medical students, practically with the same methods as Bastedo's concluded that atropine hypodermically, in not unusually large doses ($\frac{1}{80}$ grain) causes a "notable diminution" in gastric secretion and that this diminution lasts longer than the neutralization caused by the usual doses of alkalies. The atropine, in this dosage, Bennett found, slightly prolonged the emptying rate of the stomach.

This being the state of the evidence, what is the ordinary practitioner to do? His conceptions are often upset in this way, by some nervous laboratory worker rushing in with the news that a drug which he is constantly using has no pharmacologic action. He has no time to check the experimental work himself. In these circumstances, my own attitude is that if I have been convinced that the drug I have been using was doing no harm, and if I believed it was doing some good, I continued to use it, experimental evidence to the contrary notwithstanding. Often the experimental evidence has switched—witness the Bunge theory of iron, and the use of digitalis in aortic insufficiency. On this basis I see no reason for discontinuing the use of belladonna in hypersecretion.

D. *Digestants.*—In another condition of disturbed gastric secretion—the lack of digestive juices—it was inevitable that the minds of men

should try to correct the condition by supplying the juices in an artificial form. For this purpose there is available hydrochloric acid, a normal constituent of the stomach fluid and pepsin the most active of the stomach's enzymes. Pepsin, by the U. S. Pharmacopoeia standards, is required to digest 3000 times its weight of coagulated egg albumen, in the presence of 1 to 3000 hydrochloric acid at 125° F. "What a wonderful substance," exclaims Bastedo, "to have so little use in medicine!" It is not active in the presence of 0.5 per cent hydrochloric acid, is inactivated by sodium chloride solution of 2.5 per cent strength, and is inert in the presence of alkalies, such as disodium phosphate in ½ per cent strength, and sodium hydroxide in 0.01 per cent strength, and sodium bicarbonate or limewater in sufficient amounts to make a persistent alkaline reaction. It is evident that if food leaves the stomach rapidly and enters the alkaline intestine pepsin will probably not be able to continue its action.

In only three clinical conditions can we suppose, by *a priori* reasoning, is the combination of pepsin and hydrochloric acid to be of any use —in functional achylia gastrica or varying degrees of hypoacidity, in the achylia of pernicious anemia, and in cancer of the stomach.

Hydrochloric acid may be used to favor protein digestion, to lower the emptying rate of the stomach in achylia, and by this means to serve as an activator of the pancreatic secretions and bile. Crohn studying cases of achylia gastrica by the use of the fractional method of gastric analysis, found that it is necessary to give hydrochloric acid frequently in order to maintain a continuation of the gastric acidity. In an empty, fasting stomach he put 40 minims of dilute hydrochloric acid mixed with 100 c.c. of water. The total gastric acidity immediately after was 40. Twenty-five minutes later the acidity was the same as before the acid was given. As another experiment he gave 30 minims of dilute hydrochloric acid with an oatmeal test breakfast, and obtained a total acidity of 20 in fifteen minutes, of 18 at thirty minutes, and none at forty-five minutes. Repeated doses of dilute hydrochloric acid, 10 minims every half hour during digestion raised the acidity somewhat, and the rise continued for an hour and three-quarters. There is evidence to show that hydrochloric acid introduced into the stomach in achylia will slow the emptying rate—a desirable thing as the too rapid emptying in achylia may be the cause of the diarrhea. It may owe a part of its action in this condition to its antiseptic action, as the diarrhea may be partly due to the putrefaction in the intestine, the result of the failure of the acid-free gastric juice to perform its ordinary function of destroying organisms, and thus allowing them to get into the intestine.

Another action of hydrochloric acid under normal conditions, should be remembered. Its presence in the duodenum after leaving the stomach may initiate the production of secretin which is the hormone responsible for the flow of pancreatic juice. When hydrochloric acid is not present in the stomach, it is reasonable to suppose that the activation of pancreatic secretion is either diminished or is working under difficulties, and that the introduction of hydrochloric acid into the stomach would be of benefit to the entire digestion, intestinal as well as gastric.

The indications for the use of the artificial gastric digestants are self-evident from an examination of the above outlined experiments. Hydrochloric acid is of more value than pepsin. If pepsin is given, hydrochloric acid should be given with it, but not in larger dosage than half of one per cent of the total amount of liquid ingested. Supposing that the fluid in the stomach will amount to three ounces while digestion is going on, and that the amount of water in which the dilute acid is given is one ounce, the total amount of fluid in the stomach during digestion will be four ounces. Dilute hydrochloric acid of the pharmacopoeia is about 10 per cent. Eight minims of this would represent about 0.5 per cent of four ounces. But it is easy to see how difficult an exact concentration of this amount would be, with so many unknown factors.

Hydrochloric acid, on the other hand, is a valuable digestant given alone without pepsin. It will initiate the pancreatic secretion, a far more important juice than the pepsin of stomach secretion. It will help to regulate the motor functions of the stomach and thus aid in diarrheas of gastric origin.

For these purposes it must be given frequently at a meal, before, during and after.

Pancreatin is a powerful enzyme, which digests all classes of food, but especially starches. It is used for the predigestion of milk and other foods. It will not act in an acid medium and is often administered in salol coated capsules so that it will pass through the stomach unchanged and be liberated in the intestines. It is usually given blindly—that is without knowledge on the part of the physician as to the efficiency of the duodenal digestion—and we have no careful experimental basis for determining its therapeutic value.

Gastric tonics, bitters, or substances designed to increase the appetite and stimulate the flow of gastric juice, have also been criticized by Carlson, as a result of experiments upon a subject who has a permanent gastric fistula. When tinctures of gentian, calumba, humulus and condurango were placed in the stomach of this young man, or in his mouth (he had an esophageal obstruction so they never reached his

stomach if taken by mouth) they exerted no appreciable effect upon the secretion of gastric juice. Sometimes they made an already undesirable meal still more undesirable. In another series of experiments he found that bitters taken by mouth, have no effect upon the hunger mechanism, and that they even inhibit gastric tonus and hunger contractions. A rather surprising part of Carlson's experiments was that alcoholic beverages introduced into the stomach caused an inhibition both of contractions and secretion rather than stimulation. This would account for the effectiveness of champagne and brandy in cases of nausea, but would not account for the use of alcoholic beverages as appetizers. Carlson's results, however, were often repeated and always with the same result. Furthermore it is not the conclusion of a prejudiced fanatic because Carlson states that he had an impression, before the experiments began, judging from his own sensations on drinking beer at meal times, that it seemed to awaken or increase appetite.

There is some evidence on the other side. Hoppe and Moorhead independently experimented on sick dogs and found that the use of bitters increased the amount and acidity of gastric juice. Moorhead states that in normal dogs bitters have no effect, but in dogs made cachetic by bleeding, they cause an increase which is distinct and significant in hunger contractions and in secretion.

In practice, whatever explanation is given for it, the bitters and alcohol do cause at least a subjective sensation of desire for food and ability to digest it. It may be that they do this, in some people by quieting hunger, deadening antiperistaltic movements of the stomach. The inhibition of tone of the stomach may subjectively cause a desire for food. It would be very hard to convince anyone who has ever taken a cocktail before a meal that Carlson's experiments, scientific though they may be, have any significance for practical work. The explanation of their action may not be just what we think it is, but somehow, in many conditions, these drugs do act as general tonics, by increasing, or appearing to increase, the appetite and hence the ingestion of food.

Alcoholic beverages are, I believe, the most effective form of gastric tonics of this class. This is the great place of whisky, wine and beer in medicine.

In the anorexia of many cachectic diseases, whisky, wine and beer are the medicines par excellence. A tuberculous youth, with appetite gone, losing weight, sick of the sight of food, may have his nutrition improved almost beyond belief by the use of sherry wine with his meals. In the achylia of pernicious anemia, in cancer, during the fasting days of diabetes, for old people, alcohol has its usefulness.

Silver nitrate has been recommended in the treatment of ulcer of the stomach and other painful stomach conditions. Its dosage and mode of administration are described on page 693.

**2. Cathartics, Laxatives and Purgatives.—**

A. For Acute Constipation—for a single effective evacuation.

*Oleum ricini*—U.S.X. Castor oil. Dose: see below.

*Magnesii sulphas*—U.S.X. Epsom salts. Dose: 1 to 4 drams or 4 to 16 grams.

*Liquor magnesii citratis*—U.S.X. Dose: 12 ounces, or 350 c.c.

*Magnesii oxidum*—U.S.X. *Calcined magnesia.* Dose: 30 grains or 2 grams.

*Magnesii oxidum ponderosum* (heavy magnesium oxide)—U.S.X. Dose: 30 grains or 2 grams.

*Sodii sulphas*—U.S.X. Glauber's salt. Dose: 1 to 4 drams or 4 to 16 grams.

*Sodii phosphas*—U.S.X. Dose: 1 dram or 4 grams.

*Potassii et sodii tartras*—U.S.X. Rochelle salt. Dose: 2½ drams or 10 grams.

*Pulvis effervescens compositas*—U.S.X. Seidlitz powder.

Castor oil is a harmless purge. In proper dosage, for all ages it is probably the most effective that can be used to empty the gastrointestinal tract completely. Furthermore it is not irritating either to the stomach or the intestines. Its action is due to its saponification in the intestine by the pancreatic juice and the formation of ricinoleic acid, which causes violent peristalsis throughout the remainder of the intestinal tract, and results in liquid macerated stools.

*Time of Action.*—Two to six hours, usually two to three. Do not give it therefore at bedtime. If given before breakfast it will probably nauseate. The best time of day is about four o'clock in the afternoon.

*Dosage.*—For purgative effect: an adult—1 to 4 ounces (half a glassful); infant—10 drops to half a teaspoonful; child—a dram to 1 ounce, a teaspoonful to a tablespoonful or two.

It is difficult to give an overdose of castor oil because only as much is saponified as there is pancreatic juice available. The rest of the oil goes through the intestine unchanged.

*Objections.*—The intensely disagreeable taste and odor. For this reason it is nauseating and likely to be vomited.

*Methods of disguising* castor oil have been suggested as follows:

1. Ice water method (Dr. George F. Keiper). "Take a glass of ice water. Pour on the water the dose of oil. The oil will congeal into a bolus, as it were, which passes the lips, teeth and tongue as one mass, untasted."

2. Flavoring extracts. "In a small tumbler or medicine glass is placed a layer of thick syrup of any flavor desired. The glass is inclined in such a way as to coat its inside almost up to the rim. Then the oil is poured into the center of the glass, care being taken that it does not run down the side. This is topped with a layer of pleasantly flavored alcoholic fluid, such as aromatic elixir. While the dose is being taken, the edge of the glass should be placed on the lower teeth, so as to avoid straining the oil through the teeth, to which some of it might adhere. When correctly taken, the oil follows the alcoholic fluid, gliding down the tongue on the surface of the syrup, without at any time touching the gustatory membrane. Of course the patient must take the whole dose at one gulp." (Fantus, "Useful Cathartics.")

3. Capsules. It is put up by drug houses in gelatin capsules. The objection to these is that their size makes them difficult to swallow, and even so the dose is not large enough.

4. Tasteless castor oil. Several firms put up what is called "tasteless castor oil" (e.g., Kellogg's "Tasteless Castor Oil," "Laxol") the Aromatic Castor Oil of the National Formulary.

5. For infants.—It must be remembered that infants do not mind taking castor oil. The best way to give it to an infant is in a medicine dropper, allowing it to be sucked out as from a nipple.

*Uses.*—As it is always dependable, and thorough in action, at the same time nonirritating, and without danger of excessive effect, castor oil is the cathartic of choice for a single complete evacuation for invalids, infants and in pregnancy, and if a cathartic is used for preparation for surgical operations.

*In Diarrhea.*—Lauder Brunton says, "Sometimes a teaspoonful of castor oil given every morning will do more for a chronic diarrhea than anything I know."

The experience of a colleague of mine will illustrate a specific reason for this. He attended, the evening before he went away on his vacation, a dinner at his club, in honor of a friend. At this dinner was served salad with half a hard boiled egg on the lettuce. Three days later when he was at Niagara Falls he was attacked with a vigorous diarrhea. After remaining indifferent to it for several days, his wife urged him to take some castor oil. He took an ounce of it but the diarrhea persisted. After two weeks more of it he consulted a local practitioner who after

an examination lasting over several days, made a diagnosis of tuberculosis of the bowel. This naturally alarmed him greatly and he decided to go to New York and consult Dr. Janeway. When he arrived in New York he found that Dr. Janeway was on his vacation. Utterly discouraged, the diarrhea still persisting, he told his wife he was going home. He made up his mind that if he had tuberculosis of the bowel he was going to die and he might as well die at home where he would be comfortable. His wife told him he should take some more castor oil. He pointed out that he had already taken some without benefit. She said, "You did not take enough," to which he replied, "Then you take it for me." She said she would take some if he would take an equal amount; so he agreed. She bought an eight ounce bottle of castor oil, divided it into equal parts, and made him take his four ounces. Three hours later, with severe cramps, he passed a large hard calcified fecal mass. He fished it out of the toilet, split it with his knife and inside found the half of the hard boiled egg! This was four weeks after the banquet.

*Salts.*—Salts all abstract fluid into the intestines, and cause purgation, with large watery stools. For this reason, they should be given in plenty of water unless it is intended to remove fluid as in dropsy. They can be depended upon to cause a prompt evacuation in from 2 to 4 hours. Hence they are usually administered before breakfast, in order to cause a stool after breakfast. The only objection to their use is the irritating effect upon the stomach; they nearly always cause nausea, and sometimes vomiting, so should not be given in the presence of a disturbed stomach.

They are more palatable given as effervescent salts. These are made by the addition to the particular salt of soda bicarbonate and tartaric acid. Ordinarily the effervescent salts are granulated by drug manufacturers, but this is not necessary. If the physician wishes to order an effervescent salt without granulation the salt can be prescribed with soda bicarbonate and tartaric acid and, if kept dry can be preserved for a long time; only on being put in water will effervescence occur. Indeed the preparation "Sal Hepatica" is such a mixture and is not granulated.

The most certain and efficient of the salts is sodium sulphate. Magnesium oxide (milk of magnesia) is the mildest; it has the advantage of being the only one of the group that does not cause nausea and hence can be given in the presence of vomiting. It is a very useful cathartic for children, being tasteless and mild.

Sodium phosphate has for some reason, gained the place of choice in the treatment of gall bladder disease and jaundice. It is usually recommended to be taken in a glass of water and sipped before break-

fast. It cleans out the mucus and detritus in the stomach and causes a loose evacuation, which is always beneficial for gall bladder cases, as it is a frequently demonstrated fact that even the slightest amount of constipation is likely to induce an attack. But that sodium phosphate is any better than many other salts for this purpose may be doubted.

The pleasantest way to take salts is as the solution of effervescent magnesium citrate. It is put up in reenforced stoppered bottles, with an excess of citric acid, and sufficient crystallized potassium bicarbonate to neutralize the acid. The stopper retains the liberated carbon dioxide under pressure, so that on its removal effervescence occurs. The effervescence makes this, as it does any other salt, more palatable, and added to it the citric acid imparts a lemonade-like taste that is quite pleasant.

Seidlitz powders are Rochelle salts put up with soda bicarbonate and tartaric acid in separate powder papers (one white and one blue). Added in turn to a glass of water effervescence occurs.

Magnesium sulphate (Epsom salts) has other uses in medicine than as a cathartic. It is used as a cerebral depressant, in tetanus, intraspinally. It has also antispasmodic qualities applied directly to the mucous membrane of the duodenum and rectum as described in the classic paper by Meltzer which should be read by every practitioner. Meltzer pointed out that to a peristaltic movement there are two elements; there is a contraction, and in order to make that contraction effective, there must be a relaxation ahead of it. This is a general rule throughout the body; he calls it the law of contrary innervation—that to the movement of every hollow viscus there is a relaxation as well as a contraction. In the emptying of the urinary bladder, to cite an instance that is quite plain, there is the contraction of the bladder and the relaxation of the sphincter. And both must occur before the bladder can be emptied.

So in peristaltic action, he believes that the magnesium sulphate essentially causes the relaxation element. In the stomach it is changed into magnesium carbonate and sodium sulphate, the latter causing the contraction part, the former the relaxation part of the double function of peristalsis.

B. For Chronic Constipation.—

*Petrolatum liquidum.*—U.S.X. Dose: see below.

*Agar-Agar*—U.S.X. Dose: see below.

*Bran*—Not official. Dose: see below.

*Psyllum seed*—Not official. Dose: see below.

*Cascara sagrada*—U.S.X. Preparations:

*Extractum cascarae sagradae*—U.S.X. Dose: 4 grains or 0.25 gram.

*Fluid extractum cascarae sagradae*—U.S.X. Fluid extract of cascara. Dose: 15 to 30 minims or 1 to 2 c.c.

*Fluid extractum cascarae sagradae aromaticum*—U.S.X. Dose: 30 to 60 minims or 2 to 4 c.c.

In the treatment of chronic constipation it is a very poor thing to prescribe drugs at all, because their secondary effect is really constipating and they usually leave the patient worse off than he was before. Indeed in the treatment of many cases of constipation all that is needed is to withdraw the cathartics the patient is depending on, and allow the bowel to return to normal conditions of response. The drugs or preparations that are listed above, all have the advantage that they do not cause the bowel to become more sluggish than it was. For that reason they may all be used in chronic constipation, without fear of after-effects.

The first three substances named all act in much the same way. They furnish bulk to the feces. They are intended to help the constipation of that type which is due to a diet too scanty in residue.

Liquid petrolatum, or mineral oil, was introduced into medicine quite recently. It is a heavy tasteless and odorless oil, which passes through the intestine without change, without being absorbed, and without causing any active peristalsis. It is incapable of being decomposed by bacteria. Its usefulness is supposed to depend upon its ability to soften the feces, and allay irritation. Thus it is well adapted to the conditions present in spastic constipation. It initiates no peristaltic activity, so cannot be useful in atonic constipation.

The dosage varies with the individual—from a teaspoonful to a tablespoonful three times a day. At first it is likely that some of the oil will leak out of the rectum and soil the underclothes, and the dosage should be kept just below the point at which a leak will occur. As it is likely to cause a feeling of heaviness if taken after meals, it should be given an hour before meals, or at bedtime.

*Agar-agar* was introduced into medicine by Adolph Schmidt, in 1905, for use in chronic habitual constipation. It was intended for use in that variety of constipation which Schmidt showed was due to the excessive bacterial digestion of cellulose, and characterized by the passage of a small amount of dry, hard, fecal lumps. Agar-agar itself had been and still is used in the preparation of culture media for bacteriologic work. It is not liquefied or digested by bacterial growth. It passes

through the intestine unchanged, and adds bulk to the feces. It has no active peristaltic stimulating action, but gives by its bulk, something for the intestinal musculature to do. It is very useful in spastic constipation and in forms of irritable colon such as mucous colitis or diverticulosis. It is administered in dry flakes which are tasteless and insoluble in cold water. The dose is indefinite but should be very large —3 to 6 tablespoonfuls a day. Schmidt afterwards introduced a form of agar, now marketed under the trade name of "Regulin," in which cascara was mixed into the agar in very small quantities.

*Bran* is used in constipation in much the same way as agar-agar or liquid petrolatum, that is, it furnishes bulk to the feces. It is often stated that only civilized men are constipated; and that prehistoric man feeding on a diet of herbs, which have large amounts of residue, were not constipated at all. How the authors of this idea know so much about the bowels of prehistoric man might be questioned. Bran does at least have a large amount of residue. Owing to the toughness of its cellulose which holds the starch and other digestible elements within its walls, it is indeed nearly all residue.

In its administration it should be made palatable. Fantus well emphasizes the necessity of avoiding the sawdust-like tasteless messes of the health faddist. The average person, engaged more upon getting into the kingdom of heaven or upon his oil stock than upon his insides or his daily stools (and quite properly so) is able to keep up an enthusiastic interest in diets and the chewing of dry tasteless messes, fit only for a cow, for but a short time. Bran fortunately adapts itself to preparation in palatable form far better than either agar or liquid petrolatum. A very delicious breakfast food (Kellogg's "Krumbled Bran") is made from bran and there are many recipes for bran biscuits, muffins, macaroons and griddle cakes which should be prepared in his kitchen and regularly served to the intestinal invalid. A few of these recipes (taken from Fantus) are subjoined at page 339, Chapter V.

*Psyllum seeds* are small hard seeds having an outer coat which swells up and becomes mucilaginous on contact with water and other liquids. They are used in chronic constipation under much the same indications and with much the same idea (of furnishing bulk) as bran, petrolatum and agar-agar. They are practically tasteless.

*Cascara* is a stimulant to the colon. It is a cathartic, which can be used without fear of the need of increasing the dose—the common fault of all other cathartics. Indeed it can be given over long periods with the same dosage, or even with a reduction of dosage. But this commonly made statement has some exceptions, in certain individual in-

stances. It should not gripe. If it does the dose is probably too large. It is slow in action requiring several hours, usually ten.

In its administration the fluid extract or the aromatic fluid extract should be used. The plain fluid extract is bitter, and for that reason the aromatic fluid extract is often preferred. It is a flavored and sweetened preparation, but far less active than the fluid extract, as will be seen by a comparison of the dosage above.

*Method of Administration.*—Being a liquid, the fluid extract of cascara adapts itself to more exact dosage than other cathartic preparations. Pills constitute a poor form of cathartic for the patient with chronic constipation because he may find that two pills are not enough to move the bowels and three are too many. But with fluid extract of cascara he can run the dosage up until he reaches the exact number of drops required. Overdosage and consequent inurement of the bowel is thus avoided.

Being a stimulant to the colon, and having ordinarily no secondary constipating, or astringent effect, it is ideally adapted to the sluggish bowel, or what has been named atonic constipation. There are two methods of administering it in this form of constipation. One is to give, at night, that dose, in drops of the fluid extract which experiment on each individual patient has shown to be the exact amount which will produce a stool, the next morning, without griping or maceration of the stool. The better method, though more troublesome to the patient, is to administer the plain fluid extract in drop doses after meals. The patient starts with five drops three times a day and raises the dose, drop by drop at each dose, until he has reached the point where he will have a single bowel movement a day, without griping. This is then continued as long as desirable.

C. For Occasional Use.—

*Aloe*—U.S.X. Dose: 4 grains or 0.25 gram.

*Aloium*—U.S.X. Obtained from Aloes. Dose: ¼ grain or 0.015 gram.

*Podophyllum*—U.S.X. Preparation:

*Resina*—Dose: ⅙ grain or 0.01 gram.

*Senna*—U.S.X. Dose: 1 dram or 4 grams.

*Fluidextract sennae*—U.S.X. Dose: 30 minims or 2 c.c.

*Infusam sennae compositum*—N.F.V. Dose: 4 drams or 120 c.c.

*Syrupus sennae*—U.S.X. Dose: 1 dram or 4 c.c.

*Jalapa*—U.S.X. Dose: 15 grains or 1 gram.

*Pulvis jalapae compositus*—U.S.X. Dose: 30 grains or 2 grams.

*Rheum*—U.S.X. Rhubarb. Dose: 15 grains or 1 gram.

*Syrupus rhei aromaticus*—U.S.X. Dose: 2½ drams or 10 c.c.

*Colocynthis*—U.S.X. Colocynth.

*Extractum colocynthidis*—U.S.X. Dose: ½ grain or 0.015 gram.

*Hydrargyrum*—U.S.X. Mercury. Cathartic.

*Massa hydrargyri*—U.S.X. Blue mass. Dose: 4 grains or 0.25 gram.

*Hydrargyri chloridum mite.*—U.S.X. Calomel. Dose: 2½ grains or 0.15 gram.

*Phenolphthaleinum*—U.S.X. Dose: 2½ grains or 0.15 gram.

*Oleum tiglii*—U.S.X. Croton oil. Dose: 1 minim or 0.05 c.c.

*Elaterinum*—U.S.X. Elaterin. Dose: 1/20 grain or 0.003 gram.

*Cambogia*—U.S.X. Gamboge. Dose: 2 grains or 0.125 gram.

*Glycyrrhiza*—U.S.X. In Pulvis glycyrrhiza comp. U.S.X. combined with senna. Dose: 1 dram or 4 grams.

Pills are a most convenient form of administering cathartics. *Aloes* or *aloin* is the basis for most pills. It acts almost entirely upon the large intestine. But on account of its irritating effect, and that it requires larger and larger doses to produce its effect if used over long periods of time, it is a poor drug to prescribe in chronic constipation. But for occasional use—for the person who wants a cathartic once a fortnight—pills, and particularly aloes-containing pills, are ideal.

Various persons have floated their names down the river of time upon "dinner pills," the principal ingredient of which is aloes: there is Chapman's Dinner Pill (N.F.) (aloes and mastic and ipecac and oil of fennel); and Cole's Dinner Pill (N.F.) (aloes, mercury and jalap, antimony and potassium tartrate); Hall's Dinner Pill (N.F.) (aloes, glycyrrhiza and soap); and finally Lady Webster's Dinner Pill (N.F.) (aloes and mastic), which has obsessed my imagination for many years. I have no idea who Lady Webster was, but the mention of her pill brings to my imagination a vision of her in the baronial castle giving endless dinners and dispensing endless pills to cowed curates and squires, with the benevolent despotism of a strong-minded dowager, who has suddenly in mid-age become intensely interested in the large intestine.

Pills of aloin, strychnine and belladonna (N.F.) were designed to improve the action of aloin alone, relieving its griping by the anti-

spasmodic effect of belladonna. It has been criticized because aloes is a very slowly acting and belladonna a very rapidly acting drug so that the antispasmodic effect of the latter has long since worn off before the action of the aloin has begun. That this is true in practice any one can easily discover.

The compound pills of aloes and podophyllum (N.F.) constitute a far more rational combination. Podophyllum, as well as aloes, is a slowly acting cathartic, and furthermore it exerts its action on the small intestine, having been introduced as the vegetable calomel, while aloes empties the large bowel.

The Compound Pills of Aloes and Podophyllum (N.F.) have this composition:

| | | |
|---|---|---|
| Aloes | Gm. .065 | gr. 1. |
| Resin of podophyllum | .0325 | 1 – 2 |
| Extract. Belladonna fol. | .016 | 1 – 4 |
| Ext. nux vomica | .016 | 1 – 4 |

It will be seen that these also contain belladonna and strychnine, but their inclusion is not necessary.

The composition of two other pills should be known to students and practitioners. They are prescribed or ordered, daily, usually with no idea of their composition.

Compound Cathartic Pills (U.S.X.):

| | |
|---|---|
| Ext. colocynth compound | gr. 1 1 – 4 |
| Resin of jalap | gr. 1 – 3 |
| Calomel | gr. 1 |
| Gamboge | gr. 1 – 4 |

Attention is called to the very large dose of calomel in each pill. If they are taken three or four at a time, as is not uncommon with pill users, poisoning may easily occur, and indeed I know personally of two such cases. Fortunately most drug firms put out an improved compound cathartic pill, in which the dose of calomel is reduced, and druggists usually dispense these to the casual customer asking for compound cathartic pills, without a physician's prescription.

Hinckle's pills (not official in either the Pharmacopoeia or the National Formulary) have the following composition (note large amount of strychnine; 3 or 4 pills are dangerous):

| | |
|---|---|
| Cascara | gr. 1/4 |
| Aloin | gr. 1/4 |
| Resin podophyllum | gr. 1/6 |
| Ext. belladonna | gr. 1/8 |
| Strychnine | gr. 1/60 |
| Oleoresin of ginger | gr. 1/8 |

*Mercury* can be used as a laxative in two forms—calomel (Hydrarg chloridum mite U.S.X.), and blue mass (Massa hydrargyri U.S.X. Dose: 4 grains).

*Calomel* exerts most of its action upon the small intestine, it being insoluble in the stomach, but being changed by the alkaline juices of the intestine into mercury and mercuric oxide. The mercury excites peristalsis and carries a large amount of fluid and fecal material into the large bowel where the fluid is reabsorbed unless a saline purge is also given. The combination of calomel at night and salts in the morning is thus an established custom. Calomel may be given to a nauseated or vomiting patient and even seems to allay the gastric irritability in some cases, as in the vomiting of pregnancy. The dose of calomel is one grain or two grains for adults, one-quarter to one grain for children. It is often given in divided doses, ¼ gr. every quarter hour until four are taken.

*Senna* is similar in action to cascara, but more powerful. It is the favorite ingredient of patent nostrums, such as "Oriental Fig Laxative" and "Nature's Remedies," partly because it is sure in action and partly because it can be made into palatable confections. Compound glycerrhiza powder (U.S.X. Dose: 1 dram or 4 grams) has senna as its principal ingredient. The compound infusion of senna or black draught is a combination of senna and magnesium sulphate. By habitual users of senna, the leaves in powdered form are often taken straight. The dose of the fluid extract U.S.X. is 30 minims or 2 c.c., of the syrup of senna U.S.X. 1 dram or 4 c.c.

*Gamboge* (dose 2 grains or 0.125 gram) is a powerful hydragogue but seldom employed alone. Jalap (compound powder of jalap U.S.X. Dose: 30 grains or 2 grams), elaterium (triturate of elaterium U.S.X. Dose: ½ grain or 0.03 gram), and colocynth (extract of colocynth U.S.X. Dose: ¼ grain or 0.015 gram) are of the same pharmacologic action and are employed, usually in pills, for dropsy.

*Oleum Tiglii* or Croton oil (U.S.X. Dose: 1 minim or 0.05 c.c.) is a drastic cathartic, one drop of which placed on the tongue will usually cause prompt evacuation. For this reason it is especially valuable in coma where catharsis is desired but when the patient will not swallow at command.

*Phenolphthalein*, a recent addition to the list of cathartics, is of value because it lends itself to preparation in candy form. It is put up in many pleasant-tasting sugary confections by different drug firms. It can cause symptoms of poisoning with free purgation, rapid pulse and collapse, but no fatalities are known. Ordinarily very large doses up to several grains can be taken. The usual dosage is 1 to 3 grains. It requires six to twelve hours for its effect. In candy form it can be given to children and the unruly insane, who would refuse less pleasant mixtures.

*Rhubarb* has very marked secondary astringent properties, and if taken over long periods of time will have a constipating effect. For these reasons it is adapted to certain nervous constipated dyspeptics,

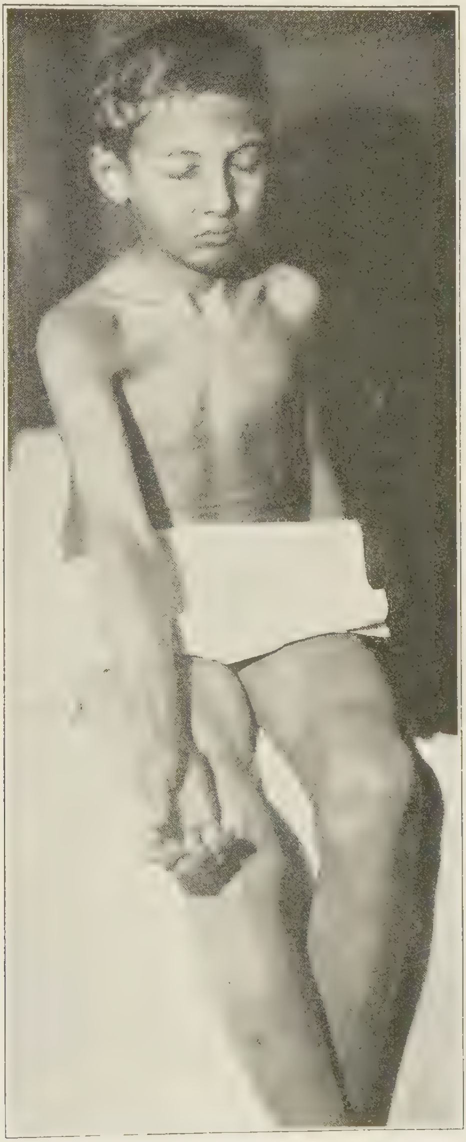


Fig. 13.—Phenolphthalein eruption. Discrete rounded or oblong pinkish spots.

whose bowels are easily upset and move many times after the use of other cathartics. As Fantus says, "it knows when to stop." An old and favorite combination is rhubarb and soda put up in tablets by many

drug firms, for this class of dyspeptics. As it has an astringent effect it is useful as a cathartic to give in the early stages of a diarrhea. It acts in six to ten hours. The dose of the extract is 4 grains, of the aromatic syrup of rhubarb, 2½ drams.

*Summary of Cathartics—Therapeutic Selection.*—For a single evacuation, at the beginning of an infectious fever, at the onset of labor or before surgical operations, etc.:

Ol. Ricini or Castor Oil.
Magnesium sulphate effervescens.
Magnesium citrate.

In the presence of nausea or vomiting:

Calomel.
Magnesium oxide.
Rhubarb and soda.

In the presence of coma:

Ol. Tiglii or croton oil.

For children:

Aromatic fluid extract cascara sagrada.
Syrup of Senna.
Compound glycyrrhiza powder.
Phenolphthalein.
Calomel.

For the insane:

Phenolphthalein.
Syrup of Senna.

For chronic spastic constipation:

Bran (preferable to agar and petrolatum because it can be made palatable given in the form of food).

For chronic atonic constipation:

Fluid extract cascara sagrada.

For occasional use:

Pills:
Hinckle's Pills.
Aloin pills, such as Lady Webster's dinner pills.
Phenolphthalein.

To remove dropsy:

Salts.
Gamboge.
Colocynth.
Jalap.
Elaterium.

Cathartics which given a nursing mother will purge the baby:

Aloes, particularly.
All vegetable cathartics, somewhat.
Salts, very slightly.

Cathartics which can cause poisoning:

Calomel.
Podophyllum.
Phenolphthalein.
Croton Oil.
Magnesium sulphate.

For hypodermic use for cathartic effect:

Phenoltetrachlorphthalein (dose: 0.4 gram).

**3. Drugs Which Act Locally on the Intestine.—**

a. Drugs Which Are Astringent in Diarrhea:

*Acidum tannicum*—U.S.X. Dose: 8 grains or 0.5 gram.
*Acidum gallicum*—U.S.X. Dose: 15 grains or 1 gram.
*Acidum acetylannicum*—U.S.X. Acetannin. Dose: 10 grains or 0.6 gram.
*Albumini tannas*—U.S.X. Albutannin. Dose: 30 grains or 2 grams.

b. Carminatives:

*Oleum menthae piperitae*—U.S.X. Oil of peppermint. Dose: 3 minims or 0.2 c.c.
*Oleum Terebinthinae rectificatum*—U.S.X. Oil of turpentine rectified. Dose: 5 minims or 0.3 c.c.
*Carbo ligni*—U.S.X. Charcoal. Dose: 15 grains or 1 gram.
*Asafoetida*—U.S.X. Dose: 3 grains or 0.25 gram.
*Tinctura asafoetidae*—U.S.X. Dose: 15 minims or 1 c.c.
*Liquor pituitarii*—U.S.X. Pituitrin. Dose: 15 minims or 1 c.c.
*Eserine*—See page 73.

c. Intestinal Antiseptics:

*Phenylis Salicylas*—U.S.X. Salol. Dose: 5 grains or 0.3 gram.
*Calomel*—See page 140.
*Bacillus bulgaricus cultures*—See page 147.
*Bacillus acidophilus cultures*—See page 147.
*Ichthyol*—See page 147.
*Bitumen Sulphonatum*—N.F.V. Sulphonated bitumen, Ictiol, Ichtholicum.

Drugs which have been used for diarrhea, and allied conditions, such as flatulence, are those which exert a general relaxing (whether central or peripheral) action on the intestinal musculature, such as opium and

belladonna, and those which exert an action inside the intestinal canal. Of course the specific diarrheas such as those due to amebae, have a distinct form of treatment, as have the diarrheas of infancy. But we are discussing here less serious, but by no means simpler forms, for which some method of medication is indicated.

No treatment of diarrhea of any form, except perhaps in infants, can be highly successful without the use of opium or of belladonna, or of both in some form. The supplementary action of morphine and atropine upon the movements of the intestine is shown in the diagram (Fig. 69). Clinically their combination has the advantage that it does not cause nausea or vomiting so frequently as morphine alone. The crude drug is, by some, preferred to morphine in diarrhea. Paregoric (Tr. opii camphorata) is a very valuable drug; it can be used, if necessary, in the diarrheas of children and its liquid form allows of very exact dosage; just sufficient number of drops should be taken to stop peristalsis or to allay it. Camphor, an ingredient of paregoric, has long been supposed to have a particularly valuable action, in diarrhea, in combination with opium. Those expert in tropical medicine say that no other combination is so valuable in Asiatic cholera. The camphor may have the same action as other volatile oils. There is a camphor and opium pill in the National Formulary. Extract of opium is preferred by some practitioners to powdered opium in diarrhea.

Tannic acid exerts its action in diarrhea by its property of precipitating albumins and gelatins. In the mouth it causes a sensation of roughness and dryness, due to the precipitation of the coating of protein layers in the mouth, and a shrinking of the superficial layers of epithelium. Its action, we may suppose, is similar in the intestines. Tannic acid itself cannot be prescribed as it is liable to derange the stomach and be completely united with albumins before it reaches the bowel. A number of synthetic drugs have been introduced, to remedy this defect. They are combinations or compounds of tannic acid and albumins or casein. They are designed to pass through the stomach unchanged and to release tannic acid in the intestines only. Leech, working in the chemical laboratory of the American Medical Association, investigated many of these products on two grounds: the claim that they would not liberate tannic acid in the stomach (i.e., an acid pepsin medium), and the claim that they would liberate it, in quantity, in the intestine (i.e., an alkaline-pancreatine mixture).

He concluded that Acetannin Calco (Calco Chemical Co.) came up to requirements in the one specimen examined, that Tannigen (The Bayer Co., Inc., dose: 3 to 10 grains or 0.2 to 0.6 gram) varied considerably in different samples, that Tannalbin and Albutannin (Merck, Dose: 30

grains or 2 grams) while "not sufficiently resistant to the acid-pepsin medium, * * * do liberate free tannic acid in the alkaline-pancreatic medium." Albutannin is now official, the official Latin name being albumini tannas.

A good method of prescribing these is in combination with the extract of opium, thus:

℞
Albutannin ʒ ii
Ext. opii gr. 1
M. and ft. caps. no. 12
Sig.: One every 2 hours.

An adjunct to the treatment of diarrheas due to intestinal infection would be a drug which would destroy microorganisms in the intestine. Several such have been designed but even the most enthusiastic of therapeutists have no faith in their powers. Zinc sulphocarbolate is one of these. Icthyol in the dose of 2 grains or 0.1 gm. every two hours is another.

Salol or phenyl salicylate (U.S.X. Dose: 3 to 8 grains) has been used for the same purpose. Calomel is perhaps as good an intestinal antiseptic as any. None of these drugs are of any great value, and are continued in works on therapeutics simply because we have no good drug of this series comparing to the action of hexamethylenamine in the urinary tract.

The best way to kill off the flora of the intestines is to replace it with a different flora. This can be accomplished by diet, or by the introduction of certain bacteria. The Bacillus bulgaricus or the lactic acid bacillus was recommended by Metchnikoff to replace our alkaline intestinal flora, but recent studies have shown that it implants itself in the intestine with great difficulty. The Bacillus acidophilus is the latest claimant for the honors. It grows rapidly in broth, implants itself well in the large intestine, in the presence of a carbohydrate, sugar or starch diet; it does not produce toxins, and breaks up carbohydrates with the production of lactic acid.

Rettger and Cheplin have administered it to patients with chronic constipation, chronic diarrhea of the dysenteric and mucous varieties, in sprue and in two cases of eczema.

*Mode of Administration.*—Rettger and Cheplin always administered it in milk. Fresh skimmed cow's milk is sterilized in one heating at 115° to 120° C., in quart lots for 22 to 24 minutes. After cooling to 37° C., the milk is inoculated with B. acidophilus in strains which have been grown, by repeated transfers, long enough in milk to develop rapidly and bring about coagulation of the casein within 24 hours at 35° to 37° C. After incubation for this period the milk is full of casein curds.

which are not tough and break apart on shaking, when the odor and flavor of the milk resemble high grade buttermilk. If other organisms have contaminated the milk, there will be the characteristic odor and character of ordinary soured milk.

This milk culture is considered much superior to broth cultures, and is administered to patients a pint to a quart a day.

In giving it to patients with constipation they usually gave also 100 grams of lactose, as lactose has a slight laxative effect. The results reported are sufficient to warrant a general trial in constipation and chronic diarrheas.

*Carminatives,* drugs designed to relieve gas in the intestines, are of three kinds. Charcoal (Carbo ligni U.S.X.) has the property of absorbing gases in its interstices. It thus contains considerable quantities of oxygen. When ingested and in the presence of bacterial decomposition, it liberates its oxygen, which hastens the decomposition process by oxidation and also absorbs the resulting gases. Practically it probably absorbs the gases that form, from whatever cause, in the large intestines. It acts as well when wet as when dry. It can be given in nearly any dosage; 15 grains three times a day ordinarily is sufficient.

The volatile oils, oil of peppermint, oil of turpentine, asafoetida, etc., are quite useful in eructations of gas from the stomach, and intestinal flatulency. Certain pharmacologists state that they act by relaxing the muscular coats of the stomach and intestines and perhaps by allowing the gas to escape when it is held in by small localized spasms. Other pharmacologists have stated that they cause increased intestinal peristalsis. Plant, in a recent study has apparently reconciled these discrepancies by showing that in very small dosage, they cause increased tone and contractions, and that a later effect, in sufficiently large dosage is a relaxation of the muscular coats of the intestines. Muirhead and Gerald showed that diluted solutions of volatile oils 1 to 50,000 caused increased intestinal tone, while concentrations of 1 to 5000 caused relaxation. As Plant points out, they are usually used in very low concentration. They appear to exert their effect by direct stimulation to the mucous membrane, atropine interfering with but not abolishing their action, while cocaine entirely stops their effectiveness.

Turpentine enemas (ʒss to ʒi or 15 to 30 c.c. of oil of turpentine in a pint of soapsuds) and oil of peppermint (5 minims) dropped on a lump of sugar, are real helps to the very uncomfortable and at times dangerous tympanites of postoperative cases, and infectious fevers.

Asafoetida may be used in the form of the emulsion (U.S.X. Dose: 4 drams or 15 c.c.) or the pills (U.S.X. each containing 3 grains or 0.2 gram) or the tincture (U.S.X. Dose: 15 minims or 1 c.c.).

Several drugs have been recommended for hypodermic use, in the severe forms of flatulency. They all act by stimulation of the intestinal musculature. They are pituitrin (Liquor hypophysin U.S.X. Dose: 15 minims or 1 c.c.), ergot, (best used hypodermically in one of the unofficial preparations of the active principle, ergotoxin), and eserine (or physostigmine. Dose: hypodermically 1/60 grain or 0.001 gram). In paralytic ileus or paresis of the bowel, a familiar postoperative condition, these drugs are also to be used. Their action is explained under the heading of antispasmodics and spasmodics in relation to the vegetative nervous system.

### 6. Drugs Which Affect the Respiratory Tract

**1. Local Application.—**

a. To Nose, Pharynx, Tonsils, etc.

*Argenti nitras*—U.S.X. Silver nitrate. Dose: 1/6 grain or 0.01 gram if used internally. For application to mucous membrane 1 to 10 per cent solution.

*Cocainae hydrochloridum*—U.S.X.

*Epinephrina*—U.S.X.

Gargles.—

*Liquor antiseptics*—N.F.V. Boric acid (2.5 per cent), thymol, eucalyptol, methyl salicylate, oil of thyme, menthol sodium salicylate, and sodium benzoate.

*Liquor aromaticus alkalinus*—N.F.V.

*Liquor sodii boratis compositus*—N.F.V. (Dobell's solution.)

Lozenges.—

*Troschisci ulmi*—N.F. Troches of elm.

*Troschi Menthae Piperitae*—Not official. Troches of peppermint.

Sprays.—

*Nebula mentholis composita*—N.F.V. (Compound menthol spray.)

*Nebula eucalyptol*—N.F.V. Eucalyptol in light liquid petroleum.

b. To Bronchi.—

*Menthol*—U.S.X. Dose: 1 grain or 0.06 gram if used internally.

*Camphor*—U.S.X. Dose: 3 grains or 0.2 gram if used internally. See page 116.

*Iodoformum*—U.S.X. Dose: see below.

*Benzoinum*—U.S.X. Benzoin.

*Tinctura Benzoini Composita*—U.S.X. Compound tincture of benzoin. Dose: see below.

*Oleum Tebebinthinae*—U.S.X. Oil of turpentine.

*Oleum Olivae*—U.S.X. Olive oil.

*Oleum Pini Pumlionis*—U.S.X. Oil of pine needles.

*Oleum eucalypti*—U.S.X. Oil of eucalyptus.

*Linimentum Ammoniae*—U.S.X. Hartshorn liniment, ammonia water (25 per cent) in sesame oil.

*Linimentum Terebinthinae Aceticum*—N. F. St. John Long's liniment. Oil of turpentine (40 per cent) and acetic acid (8 per cent) with oil of lemon, fresh egg and rose water.

*Lipoidal.* Not official. An iodized vegetable oil containing 40 per cent of iodine by weight. Dose: large quantities can be injected into the trachea without danger. Usually 15-20 c.c. are sufficient.

**2. To Relieve Spasm of the Bronchi.—**

*Morphine*—See page 66.

*Belladonna*—See page 73.

*Epinephrin*—See page 73.

*Stromonium*—U.S.X. Stromonium leaves. To smoke.

**3. Expectorants.—**

*Ammonii Chloridum*—U.S.X. Ammonium chloride. Dose: 5 grains or 0.3 gram.

*Terpene Hydras*—U.S.X. Terpin hydrate. Dose: 4 grains or 0.25 gram.

*Antimonii et Potassii Tartras*—U.S.X. (Tartar emetic, tartrated antimony). Dose: $\frac{1}{30}$ to $\frac{1}{2}$ grain or 0.0018 to 0.005 gram.

*Acidum Hydrocyanicum Dilatum*—U.S.X. Dilute hydrocyanic acid. Dose: 1 minim or 0.1 c.c.

*Ipecacuanha*—U.S.X.

*Pulvis ipecacuanha et opii*—U.S.X. Dover's powder. Dose: 8 grains or 0.5 gram.

*Potassii Iodidum*—U.S.X. (KI. iodide of potash). Dose: see below.

*Menstrua for cough mixtures:*

*Syrupus Tolu*—U.S.X. Sprup of Tolu. Dose: 4 drams or 15 c.c.

*Syrup Pruni Virginianae*—U.S.X. Syrup of wild cherry. Dose: 1 dram or 4 c.c.

**4. To Reduce Cough.—**

*Codeine*—See page 66.

*Dionin*—See page 66.

**5. As Respiratory Antiseptics.—**

*Cresotum*—U.S.X. Creosote. Dose: 1 to 4 minims or 0.06 to 0.25 c.c.

*Guaiacolis Carbonas*—U.S.X. Guaiacol carbonate. Dose: 15 grains or 1 gram.

There are no great respiratory drugs. It is true we have drugs which are effective in relieving spasms of the bronchi, as in asthma, but they are only drugs, epinephrin perhaps excepted, which relieve spasm elsewhere.

For the pathologic conditions common in the respiratory tract we might ask several things from drugs. Infection, catarrhal inflammation, is the common disease of the trachea and bronchi. The first symptoms of this are a feeling of turgescence and constriction, and a dry unproductive cough. Later the mucous secretion is stimulated, and the patient is more comfortable except for the excessive coughing and expectoration. We need first a good drug which will hasten the process of inflammation past the uncomfortable first stages, relieve the irritation and turgescence of the mucous membrane, and allay the impulse to cough. We need later a drug which will liquefy and disinfect the too copious bronchial secretion. There are no effective drugs of either sort. That we have set down above a large number of the drugs is simply an indication of the fact that men are still looking for really good ones. But as Forcheimer says, "The expectorant drugs are of little value, but I should not like to be without them."

With this reservation let us recount briefly such methods as we have for the use of drugs in respiratory disease. No methods of treatment are commoner than the use of lozenges, sprays, gargles, etc., and the physician should inform himself of the composition of these various preparations.

In the common infections of the upper respiratory tract, nose, throat and tonsils, local applications of silver nitrate are without a peer. In 10 per cent or 20 per cent solutions applied directly to the mucous membrane, on an applicator, the first effect is to cauterize the superficial area, and make the patient intensely uncomfortable. But the later effect is to stimulate the process of inflammation and cut short the attack. Cocaine (1 per cent) and adrenalin applied in the same way in the nose, contract the erectile tissue and render breathing easier temporarily but they do not have the permanent good effects of silver nitrate.

Lozenges or troches are favorite means which the laity employ to allay discomfort in the throat. They are made of a base of sugar or gum, mixed with some small amounts of drugs, and compressed into tablets. Every practitioner should have a particular pet one to advise. Each of the various drug firms puts up several, but the National Formulary has a number of excellent ones, which might as well be ordered. Slippery elm bark has long had a prodigious reputation in this line, and can be ordered in the Troches of elm of the N.F. The cool and soothing taste of peppermint may be had in the troches of peppermint N.F.

Gargles also may be employed without ordering any ready-made product. Liquor antisepticus of the N.F. is for all purposes exactly like Listerine of the advertisements. Liquor aromaticus alkalinus is the N.F. Glyco-thymoline. And the most soothing of all, on account of its phenol content, Dobell's solution may be ordered as liquor sodii boratis compositus, or simply as Dobell's solution.

Sprays, used in a De Vilbiss atomizer, are comforting in the stage of secretion of rhinitis.. The oils, naturally, and menthol and camphor are valuable here. Again the National Formulary provides us with adequate preparations, the compound menthol spray, eucalyptal spray, etc. The "chloretone inhalant" of Parke Davis & Co. is a pleasant spray or inhalant, and may be easier to obtain quickly at the average pharmacy.

Local applications may also be made to inflammatory processes, deeper down, in the bronchi. The value of applications such as we used to get in our young days, of hartshorn liniment applied to the chest in front of a warm fire, was largely in the effect of the inhalation of the vapors, and the consequent softening of the bronchial secretion.

At present the widespread popularity of the much advertised Vick's Vapo-Rub, attests to the favor which this method still retains among the public.

The use of the croup kettle or of inhalations of various drugs is a more direct way of using this aid. The simplest and usually most soothing of all is compound tincture of benzoin. In the "tight stage" of a bronchitis no other treatment is usually so pleasing. In children with tight croupy chests or laryngismus stridulus it is almost imperative to use something of the kind. One advantage is that the croup kettle with the benzoin on top of the water may be left going all night. The more volatile oils, camphor, menthol, eucalyptus, etc., are usually too irritating to a sensitive mucous membrane to be employed in the early stages, but when the secretion is free, and in chronic bronchitis and bronchiectasis they are valuable both to loosen and liquefy the secretion and as deodorants.

An inhalation which is pleasant, and elegant in appearance and odor is this one:

℞
Menthol
Camphor āā ʒiv 15.
(These rubbed together in a mortar, will form a liquid.)—Add
Ol. Pini Pumilionis
Ol. Terebinthinae
Ol. Eucalypti āā ℥i 30.
Sig: Teaspoonful on a pan or kettle of boiling water and inhale the fumes.

A most valuable method of treating the profuse secretion of bronchiectasis and chronic bronchitis and sometimes of treating the spasms of asthma is the direct instillation into the glottis of menthol or iodoform and olive oil.

In asthma, morphine and atropine are the surest of drugs. Adrenalin may be tried; its action is of a semispecific for anaphylaxis or allergy, of which asthma is a manifestation. But it will neither be so certain nor so effective as the former two. Stramonium leaves and lobelia leaves are sometimes offered to asthmatics in the form of cigarettes.

Among the expectorants, it is to be remembered that any of the emetics have an expectorant action in small doses. In this connection it may be well to remember the high regard in which antimony was held by our predecessors. In the quotation at the head of this chapter antimony is mentioned as one of the four great drugs used by three generations of physicians. A little book by an older London consultant, Dr. Eustace Smith, called "Some Common Remedies" has a chapter entitled, "An Unjustly Neglected Remedy—Tartrated Antimony." One of the uses he recommends it for is in the early stage of bronchitis and bronchopneumonia. Inasmuch as our other remedies are of little value, it may be well to go back and investigate this practice of an earlier day. "A young house-physician," says Dr. Smith, "will order a patient who is suffering from a severe pulmonary catarrh a mixture containing carbonate of ammonia, and other stimulating expectorants as a matter of course and in total disregard of the stage of the derangement or the character of the symptoms. But in the management of a bronchial catarrh each class of remedy has its own time for serviceable action, and is useless or worse than useless if given out of its due season. The whole treatment of this derangement consists in unloading the congested vessels and setting up free secretion as a first and indispensable step before making any attempt to reduce the amount of expectoration. As long as the cough is hard, secretion is to be encouraged and not checked. To give ammonia, squill, paregoric and other stimulating and antispasmodic drugs in the early stage of

the catarrh is to make the cough harder and the chest tighter, and greatly to aggravate the discomfort of the patient if not to produce worse ill-consequences. By such means I am convinced that what should have been a mild indisposition has often been aggravated into a serious illness by driving the catarrh further and further into the more minute tubes, and that in children a moderate bronchitis has not seldom been turned into a bronchopneumonia. The use of these remedies should be reserved strictly for the later stages of catarrh when the cough has become perfectly loose from a free secretion of mucus. The earlier remedies have then finished their work, and the time has come for stimulants and astringents to take their place, and begin their task of bracing up the relaxed mucous membrane and guiding the complaint to a satisfactory issue. Antimony is not employed with any view of depressing the patient, and therefore it is advisable to prescribe it in small doses, frequently repeated, rather than in large doses given at longer intervals. It not only acts more efficiently when used in this way, but its effect can be more easily noted, and the dose repeated more or less often according as it may seem desirable. It is well to combine the drug with nitrate of potash, acetate of ammonia, spirits of nitrous ether, or such other things as have a diaphoretic action upon the skin, for all these exercise a similar influence upon the bronchial mucous membrane. The most convenient form is the vinum antimoniale, of which a dose of from 2 or 3 to 10 or 15 minims, according to the age and condition of the patient, may be given, combined as above, every hour or two hours as long as the symptoms are acute. Great severity in the attack is no bar to the use of the drug; indeed, the opposite is the case, for when the distress is great, the breathing difficult, the coughing hacking and incessant, and the pulse small and feeble, the beneficial effects of the remedy are the most decided, and it will be noted that the lividity and discomfort abate and the feeble pulse gets fuller and stronger as the secretion from the lungs gets more and more abundant and free."

For these purposes if ordered in a cough mixture antimony and potassium tartrate should be ordered only in dosage of about $\frac{1}{30}$ of a grain to the dose.

Another practice of an earlier day is that of Davies who speaks of the "magical effects" of belladonna used as an inhalant in acute bronchitis; 1 grain (0.065 gram) extract of belladonna in half an ounce of water, used in Siegel's inhaler.

Iodide of potassium is a drug which was once used in suspected cases of tuberculosis, in order to cause a slight secretion in the bronchi and alveoli of the lungs and thus render the detection of râles the more easy. It is seldom used now for that purpose, but it is well to remember

that this older practice does prove that it was efficient as an expectorant. It is also an invariable ingredient of asthma mixtures.

To reduce cough, if for any reason it is indicated, we have dionin and codeine, both alkaloids of opium. Each has advocates for the place of honor as the best depressor of the coughing center. They are often combined with ammonium chloride and terpene hydrate in cough mixtures. This procedure is apparently most irrational, as, theoretically the ammonium chloride or terpene hydrate promotes secretion and the dionin and codeine prevent coughing and getting rid of it. Actually, however, the combination is not so disastrous. The opiates relax the muscles, and relieve the tight feeling and the menstrua, tolu or wild cherry, help to bring up the mucus.

The menstrua for cough mixtures, syrup of tolu or syrup of wild cherry, are themselves as valuable cough remedies as we have, short of the opiates. They are sugary and sugars have a soothing effect upon the pharynx and epiglottis. They have besides an aromatic exhalation which acts as an inhalant as they are being swallowed.

It would be pleasant to have a disinfectant drug which would be excreted through the bronchial mucosa and would destroy bacteria. In the clinical lectures of Trousseau reference to such drugs is common. Creosote particularly was a favorite of his. Creosote, undoubtedly, if taken by mouth, is excreted by the bronchial mucosa because it can be smelled in the sputum. As a deodorant, then at least, it may be used, but it is not likely that it reaches the lung in such concentration as to be valuable as a disinfectant. In tuberculosis its use is justifiable upon a different ground. I usually order it to be given to the patient with a dropper and empty capsules; one, two, three or four drops to be taken two or three times a day as the patient can stand it. Guaiacol carbonate, a derivative of creosote is less irritating to the stomach as it does not liberate guaiacol until it enters the intestines.

In the treatment of a large number of chronic respiratory infections, nontuberculous in nature, the injection of lipiodol into the trachea, from whence it goes into the entire bronchial tree has met with a great deal of success. The method is also useful for diagnosis: the lipiodal throws a shadow on the x-ray screen and many of these old bronchiectatic cases, whose chests showed little on an ordinary x-ray plate, are seen to have large septic cavities all over when they are outlined by the oil. The technic of injection of the oil is much easier than might be expected. The earlier methods using the bronchoscope and puncturing the cricothyroid cartilage have been replaced by the simple supra glottic method in which no instruments are required other than a syringe, and a curved

cannula such as is pictured in Fig. 14. It can be learned by any internist, or general practitioner, the services of a laryngologist being entirely unnecessary.

The following rules may be helpful.

Always inform the patient as to what you are attempting to do and make him realize that his cooperation is essential to the success of the injection. State definitely that no operation is to be performed, no incision made, and no pain caused. Instruct the patient that it is impera-

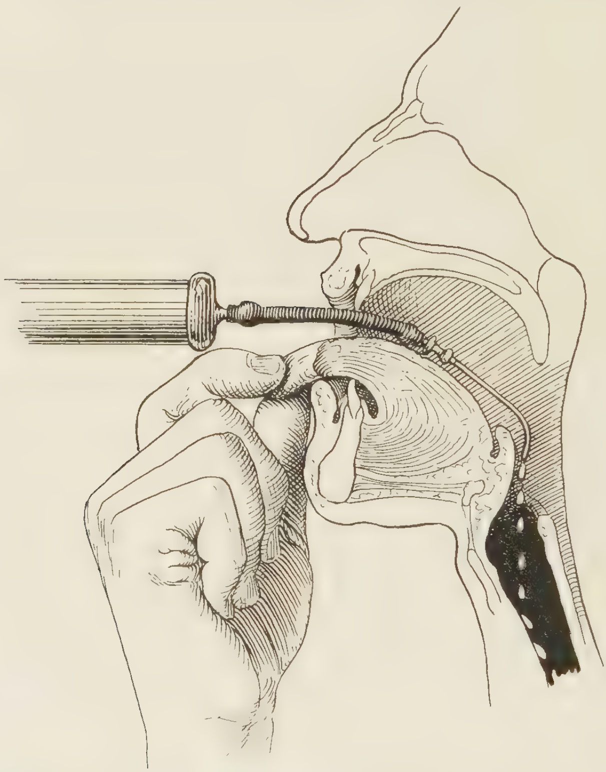


Fig. 14.—Technic of lipiodol instillation into trachea. Cocainization of the pharynx has preceded this step. The patient holds his own tongue. The oil is instilled as inspiration occurs.

tive for him to refrain from coughing and swallowing. Complete relaxation of the patient is necessary. Psychic anesthesia is needed but is more difficult to secure in the presence of onlookers. The local anesthetic solutions and iodized oil should be warmed before use to prevent reflex cough. The pharynx and larynx should be sprayed with a 5 per cent cocaine or butyn solution. As soon as the anesthetic has taken effect, as evidenced by the patient's subjective feeling of a lump in the throat, the injection of the oil may be begun. The tongue is drawn for-

ward and the syringe full of warm oil with cannula attached is thrust into the mouth until the tip is above the larynx. As the patient breathes, a stream of oil is allowed to escape just over the open glottis and can be seen sucked by the inspiration into the trachea. During expiration

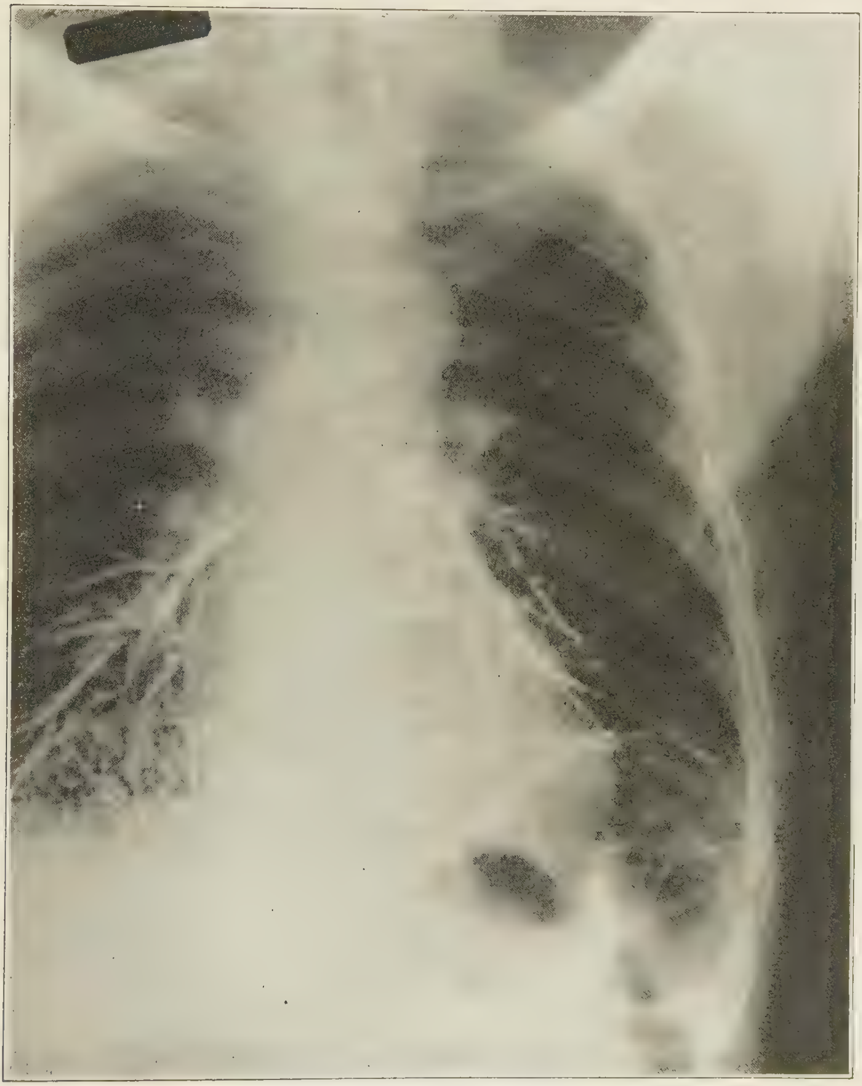


Fig. 15.—Lipiodol injection of bronchi. No disease.

the flow of oil is stopped, to be resumed as the patient once more breathes in. Some operators allow a little lake of oil to accumulate in the glottis to be breathed in at the moment of inspiration. Fifteen to twenty c.c. of the oil will fill a large part of the bronchial tree and make a good

radiograph. For therapeutic purposes injections may be repeated every two or three days. When patients have become accustomed to the procedure, local anesthesia may usually be stopped. After injection the oil may be diverted to whatever lung field needs treatment by altering the

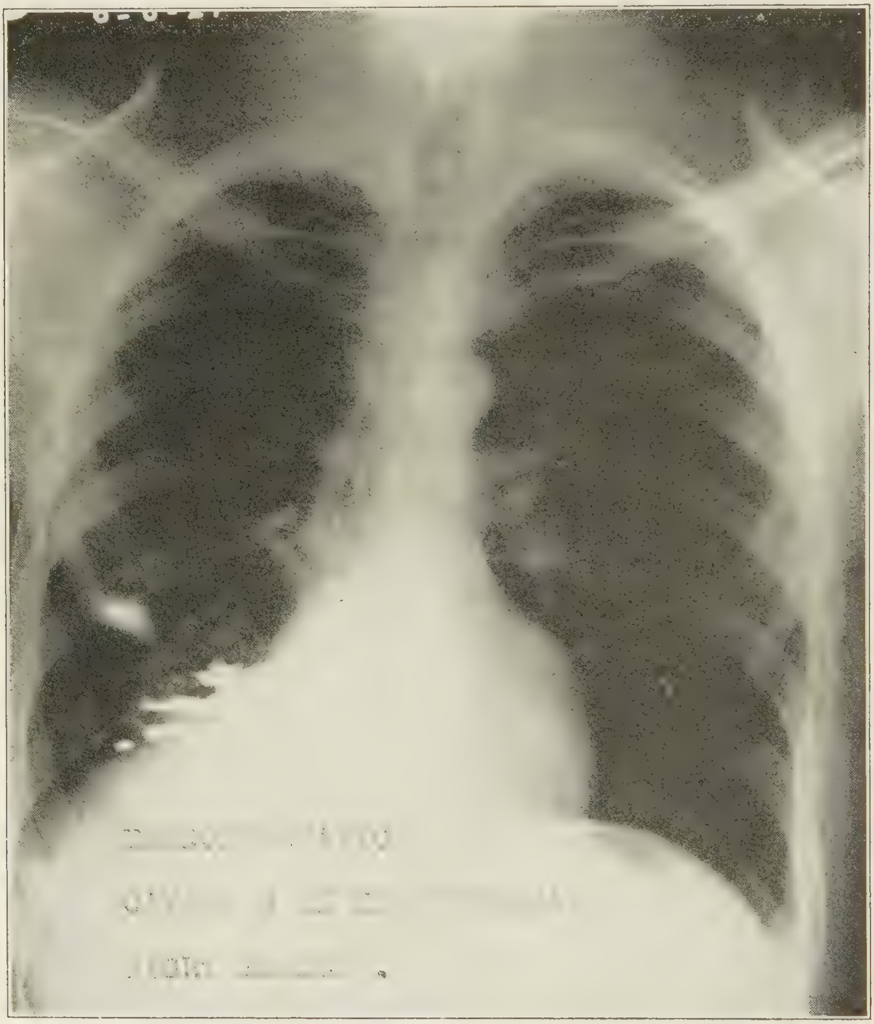


Fig. 16.—Lipiodol injection of bronchiectasis.

patient's position; i.e., if the lower right lung has an abscess or bronchiectatic cavity, the patient is to rest for half an hour on the right side with the head and shoulders slightly raised.

These drugs used for effect upon the respiratory tract have been considered at a length which perhaps their pharmacologic activity does not

warrant. But this has been done deliberately because they are used so frequently by the practitioner, and because, in spite of that, he usually has not a clear knowledge of their action and combinations.

### 7. Diaphoretics

*Pilocarpinae Hydrochloridum*—U.S.X. Dose: 1/6 grain or 0.01 gram by mouth; 1/12 grain or 0.005 gram by hypodermic.

*Ipecacuanha*—(For description see page 56.)

*Pulvis ipecacuanha et opii*—U.S.X. Dover's powder. Dose: 8 grains or 0.5 gram.

*Antimonii et Potassii Tartras*—U.S.X. Tartar emetic. Dose: 1/12 grain or 0.005 gram.

*Spiritus Aethylis Nitritis*—U.S.X. Sweet spirits of nitre. Dose: 30 minims or 2 c.c.

*Liquor Ammonii Acetatis*—U.S.X. Spirit of Mindererus. Dose: 4 drams or 15 c.c.

Diaphoresis or sweating may be desired in trying to get rid of excessive fluid and toxins, in the course of a nephritis, by means of utilizing the eliminative action of the skin, in lieu of the diseased kidneys. It is also used in helping to rid the body of toxins, in the early stages of an infectious fever, even so mild an infection as a bronchitis; under these circumstances diuresis is also induced.

While the indications for diaphoresis are very limited, in the opinion of the writer, and while also the best and safest methods are by hydrotherapy and heat therapy, still if drugs are to be used for this purpose, the ones listed above are the best.

Pilocarpine exerts a stimulating effect, through the nervous system, on many glands, salivary, sebaceous, lachrymal, etc. It can be given hypodermically and will cause profuse perspiration. It is often given at the beginning of a hot pack to initiate the act of perspiration. It is however not without its dangers, as its final pharmacologic action is paralysis of the heart.

Ipecac, like other drugs which have an emetic action, also induces sweating. Dover's powder, a favorite preparation of Osler's—no other preparation appears so frequently in his pages—is used in bronchitis and other infections, alike for its eliminative and sedative effect. Spirits Aetheris Nitrosus and Liquor Ammonium Acetatis are referred to below (section on diuretics) for their diaphoretic and diuretic actions in fevers.

## 8. Drugs Which Affect the Urinary System

**a. Diuretics.—**

CAFFEINA—U.S.X.

*Caffeina Citrata*—U.S.X. Dose: ½ to 5 grains or 0.012 to 0.3 gram.

*Caffeinae Citras Effervescens*—U.S.IX. Dose: 1 dram. 4 grams.

*Theobrominae Sodio-salicylas*—U.S.X. (Diuretin.) Dose: 5 to 15 grains or 0.3 to 1 gram.

*Theophyllina*—U.S.X. (Dimethylxanthine, Theocin.) Dose: 1 to 4 grains or 0.06 to 0.25 gram.

*Potassii citras*—U.S.X. Dose: 5 to 15 grains or 0.3 to 1 gram.

*Potassium citrate effervescens*—U.S.X. Dose: 1 dram or 4 gram.

*Potassii acetas*—U.S.X. Dose: 15 grains or 1 gram.

*Urea*—Dose: 15 grains or 1 gram.

*Aether Nitrosus*—

*Spiritus Aethylis Nitritis*—U.S.X. (Sweet spirits of nitre.) Dose: 30 minims or 2 c.c.

*Digitalis*—For description see page 92.

*Strophanthus*—For description see page 92.

*Squill*—For description see page 92.

*Novasurol*—For description see page 119.

Diuretics are like prosperous friends, most useless when most needed. In health they will all cause an increased flow of urine. In disease of the tubular epithelium or glomeruli of the kidneys, or in suppression of urine, they practically do not act at all.

They act in different ways. Caffeine, theobromine sodio-salicylate and theophylline probably exert their effect by direct action on the kidney epithelium, the potassium and saline diuretics, by increasing the alkaline reserve and increasing the exchange of fluid between the blood and lymph, the digitalis group by increasing the flow of blood in the kidneys. For the action of Urea, a powerful diuretic when used intravenously, there is no satisfactory explanation.

In infectious diseases, especially in children, a combination, frequently mentioned by Osler, is this:

℞

| | | |
|---|---|---|
| Potassium Citrate | ʒ ii | 10. |
| Liq. Ammonium Acetatis | ℥ iii | 100. |
| Spts. Aethylis Nitritis | ℥ i | 30. |
| Syr. Limonis | ℥ vi | 200. |

M. and ft. Sol.

Sig.: Four (for adults) teaspoonfuls every hour.

This causes, of course, profuse sweating and diuresis, and depends for the effectiveness of its therapeutic effect upon the elimination of toxins.

In edema due to myocardial disease the digitalis group, which have a strong diuretic action, noted by Withering (see Digitalis), will be the drugs of choice. Their action may be enhanced at times by the use of theobromine sodio-salicylate and theophylline.

In arteriosclerosis with symptoms of slight toxicity and a little edema, theobromine sodio-salicylate often has splendid results. Its use has been praised by Cabot.

In some cases of nephritis, diuretics of either the digitalis group (if there is circulatory failure) or of the caffeine group may be used. Ordinarily their use is unnecessary or fruitless.

A diuretic mixture which has long been employed successfully, or at least to the satisfaction of many practitioners, is that known as Basham's Mixture. It was introduced into practice by W. R. Basham, who wrote in his book on dropsy in 1847 that it is desirable for patients with Bright's Disease to have iron and that "in combination with liquor ammoniae acetatis and acetic acid, I have reason to think that this combination is more effective than when the sesquichloride is given with water only. The liquor ammoniae acetatis must be first rendered acid before the tincture is added, otherwise the ammonia chloride of iron is precipitated, which is with difficulty redissolved by the excess of acetic acid. The following formula is used:

℞

| | | |
|---|---|---|
| Liq. Ammoniae Acetatis | ʒ i | 4. |
| Acidi Acetici diluti | ♏ xx | 1. |
| Tinct. Ferri Sesquichloridi | ♏ x | .5 |
| Aquae | ℥ i | 30. |

Misce: fiat haustus. "

This mixture under the name of Liquor Ferri et Ammonii Acetatis is official and is given the dosage of 4 drams or 15 c.c.

**b. Urinary Antiseptics:**

*Methenamina*—U.S.X. (Hexamethylenamine urotropine, formin). Dose: 4 grains or 0.25 gram.

*Acroflavine*—Not official. Dose: 1 to 5 grains (0.5 to 0.3 gram).

*Methenamina* ($(CH_2)_6N_4$) is excreted chiefly by the urine. In the presence of acids it combines with them to form salts. "These salts tend to lose formaldehyde (HCOH) and most acids decompose the base completely with the liberation of formaldehyde."*

*Useful Drugs, Press of the American Medical Association, 1920.

Formaldehyde or formalin is a powerful antiseptic, equally as efficient as bichloride of mercury. Hexamethylenamine will liberate sufficient formaldehyde in the urine, if the urine is acid, to destroy all the organisms of certain groups. The colon-typhoid group is particularly susceptible to its action. Pus infections are somewhat less so. Tubercle bacilli are not affected.

The indications for its use then are plain. In colon-bacillus pyelitis and cystitis of a mild type it is almost specific. The colon bacillus grows in the urine as if it were a tissue. Hexamethylenamine liberates an antiseptic into this tissue, the urine, which is especially antagonistic to the colon bacillus. In typhoid fever, the bacilli may infect the urine, the pelvis of the kidney and the bladder. Here too hexamethylenamine is of good service. It is of no value in tuberculosis of the kidney, and little in staphylococcic and streptococcic infections. It will not prevent nephritis if given early in scarlet fever, and indeed can be irritating to the kidney if given in too large amounts. While it is excreted in the bile and the cerebrospinal fluid, its use in infections of the biliary tract and in meningitis is negative, and has been discontinued.

It should be determined whether or not the urine is acid before it is given. If not, substances to render the urine acid must be administered at the same time. Sodium biphosphate, or acid sodium phosphate (not official—Dose: 15 to 20 grains or 1 to 1.5 gram.), and sodium benzoate (U.S.X. Dose: 15 grains or 1 gram), both do this. The dose of hexamethylenamine is usually given as 5 grains, but it takes larger doses than this to obtain its action in most cases. It should be given in plenty of water, 15 grains to a dose every 2 to 4 hours. Sodium biphosphate or sodium benzoate should not be given at the same time as the hexamethylenamine is usually given as 5 grains, but it takes larger doses it is likely to decompose the hexamethylenamine in the stomach. It should be given at alternate hours—hexamethylenamine one hour, sodium biphosphate the next—in doses of 15 grains.

Practitioners who specialize in genitourinary surgery are not very enthusiastic in their advocacy of hexamethylenamine. I believe that there is a reason for this. They get the cases which have not responded to the simple medication. So long as the infection is confined to the urine itself, the hexamethylenamine will do good. But when the tissue of the kidney pelvis and bladder wall becomes involved, it fails in its effects. These supply a continuous source of reinfection, and the urologist is forced to open up the ureter, to drain the pelvis or to use silver nitrate instillation in the bladder. In the cystitis of prostatic hypertrophy, hexamethylenamine is of little real value.

In the colon bacillus pyelitis of children it may be given in dosage of

3 to 5 grains, usually 3 grains for a child of three years, every 2 to 4 hours. In an extensive experience no case of hematuria resulted.

Edwin G. Davis, after some experimental work conducted with care, recommends the use of proflavine (diaminomethyl acridinium sulphate) and acroflavine (diaminomethyl acridinium chloride), in doses from 0.05 to 0.3 gram for acroflavine by mouth. These substances are dyes, and, unlike hexamethylenamine, will act in an alkaline urine. Davis plated out septic urines, on culture media, before and after use and found that colonies both of colon bacillus and of staphylococcus, disappeared from the urine after the use of these drugs. They should be of value in urinary infections in prostatic obstruction (preparatory to operation) and other pus infections, when the urine is alkaline and cannot be made acid. Davis criticizes hexamethylenamine thus: "The liberation of formalin at the kidney level is open to question. In alkaline urine the drug is inert. Hematuria following the administration of urotropin in ordinary dosage, is not rare. The most serious argument against urotropin, however, is its very frequent clinical inefficiency."

Dr. Young, of Baltimore, in preparing a paper as part of a symposium on the use of drugs in genitourinary diseases, sent out to a number of specialists a request for a list of drugs which they found most useful. In summing up the replies he has this to say of urinary antiseptics which may be taken as the sum of enlightened modern opinion on the subject. It may, however, be well to remember that these people do not often see children with colon bacilluria.

"Internal Urinary Antiseptics.—For many generations a great list of drugs has been recommended as urinary antiseptics, etc. We have not space even to name a small portion of them; santal, copaiba, cubebs, juniper, buchu, hexamethylenamine and methylene blue are among the best known. Of the first three, oleum santali is recognized perhaps to be the best. While modern scientific investigation has tended to discredit its value, our urologic plebiscite shows it still to be in popular favor—particularly in acute gonorrhea.

"Hexamethylenamine is chiefly excreted in the urine and gives rise to formaldehyde in the presence of free acid. When urine is alkaline this decomposition does not occur and the drug is not effective. The drug should be given in good quantity, from 60 to 90 grains daily, water restricted and acid sodium phosphate (administered between doses of hexamethylenamine) from 5 to 15 grains every four hours to insure marked acidity of urine. Its main usage is to prevent instrumental infection of the bladder.

"Investigations have been carried out at the Brady Urological Institute by Davis and White with the object first of producing a compound

with phenolsulphonephthalein which would be eliminated in the urine as an antiseptic, and one such compound, chlormercury fluorescein, experimentally possessed all the required properties—produced antiseptic urine without injury to the animal.

"Further experiments showed that both acriflavine and proflavine given intravenously in rabbits (5 mg. per kilogram) produced antiseptic urine without injury to the animal. The rabbit's urine is alkaline. The same drugs failed in dogs whose urine is acid. Davis has recently carried out similar studies with 204 anilin dyes, 15 of which were efficient as antiseptics when added to voided urine, were excreted by the kidney and were nontoxic. Only two of these, acriflavine, and proflavine, produced antiseptic urine (as previously shown). Clinical tests have not yet been made. There is great hope of accomplishing valuable results along these lines in the near future. Davis thinks that dyes of the triphenylmethane, xanthone acridin and azin groups (particularly the latter) give more promise of success."

**c. Urinary Sedatives.—**

*Hyoscyamus*—U.S.X.
*Tinctura Hyoscyami*—U.S.X. Dose: 30 minims or 2 c.c.
*Fluid Extractum Hyoscyami*—U.S.X. Dose: 3 minims or 2 c.c.
*Buchu*—U.S.X.
*Fluid Extract Buchu*—U.S.X. Dose: 30 minims or 2 c.c.
*Argenti Nitras*—U.S.X. (Silver Nitrate.) Dose: local application.

Occasionally the practitioner, even he who devotes himself particularly to internal medicine, will be compelled to treat a case of frequent urination. The cause of this may be diabetes mellitus or diabetes insipidus or interstitial nephritis, and the treatment will be directed at the general condition, as described under the headings for those diseases. But it may be due to inflammation or irritability of the bladder. The best thing to do under the circumstances is to call a urologist in consultation, and ask him to decide by cystoscopic examination and other procedures, whether the cause be an infection or stone of the kidney or bladder, a Hunner's ulcer of the bladder or whatever. He will very likely relieve it, if it is a relatively simple condition, by irrigations of silver nitrate. But it has more than once been my experience that no particular lesion is found by the urologist. In these cases, and if a urologist is not available, or before he arrives, it is well to try a remedy known to the older generation, the fluid extract or the tincture of hyoscyamus. The fluid extract is perhaps best selected, and it should be given in drop doses beginning with five every two hours and raising

the amount, drop by drop, every other dose, until relief is obtained. As high as 20 or even 30 drops can be given without symptoms of the pharmacologic limits having been reached, as will be evidenced by flushing of the face, and dryness of the pharynx.

### 9. Tonics and Alteratives

A. Oleum Morrhuae—U.S.X. Cod Liver Oil. Dose: 2½ drams or 10 c.c.

This oil, used first by fishermen in the North Sea, as a general tonic when taken by mouth over any long period of time, increases weight and strength in debilitated individuals. Why this is so has caused some speculation. The explanation of the older skeptics was that it was simply a food and had a high fat content. But the results of its use in some diseases, notably rickets and tuberculosis, were so good that pharmacologists began to cast about for some other reason. They pointed out the iodine content and the lecithoid bodies present. Later when the existence of vitamines became known it was pointed out that cod-liver oil contained a high percentage of fat soluble vitamine—A. Whatever the explanation, it does unquestionably act better than a mere fat-food.

In rickets, for instance, Park and Howland, after a most painstaking study of 50 cases, state that they consider it a specific. They quote the work of Schabad who concludes that cod-liver oil increases the retention of calcium in rickets. They studied their cases under the x-ray. watching the deposition of bone in the diseased epiphyses, while the patient was taking no treatment except the administration of cod-liver oil. The changes were seen to begin during the second, third and fourth week of administration. This work of Park and Howland puts the administration of cod-liver oil on a firm theoretical basis.

In tuberculosis we have not such good reasons for its use, but empirically it does assist in building up a tuberculous patient's nutrition. Whether this is because there may be a calcium defect in tuberculosis, and the oil, according to Schabad, corrects this, cannot with certainty be said.

b. Hypophosphites:

*Calcii hypophosphis*—N.F.V.

*Syrupus Hypophosphitum*—N.F.V. Calcium hypophosphite, potassium hypophosphite, and sodium hypophosphite in glycerin and syrup. Dose: 2½ drams or 10 c.c.

*Syrupus Hypophosphitum Compositus*—N.F.V. The above salts with ferric manganese strychnine hypophosphites and quinine. Dose: 2 drams or 8 c.c.

The hypophosphites were introduced into medicine largely as a remedy for tuberculosis. They remain as one of the "false specifics." They remain, too, as largely used general tonics, in the form either of the syrup or the compound syrup. There is no good experimental basis for their use: indeed it is hard to define what, theoretically, a tonic does. They were supposed partly to replace the mineral losses of tuberculosis: and if rest, open air and food are insisted on as primaries they seem to have some augmenting effect. There is no doubt that under their use, patients who need "tonicking" feel better: whether this is psychotherapy or pharmacology is hard to say. At least they do no harm.

c. NUX VOMICA OR STRYCHNINE—

*Extractum Nucis Vomicae*—U.S.X. Dose: ¼ grain or 0.015 gram.

*Tinctura Nucis Vomicae*—U.S.X. Dose: 8 minims or 0.5 c.c.

*Strychninae Sulphus*—U.S.X. Dose: $\frac{1}{40}$ grain or 0.0015 gram.

Strychnine has a very marked pharmacologic action, in its general tonic action on the entire central nervous system, particularly the spinal cord. The reflex arc is immensely more sensitive under its influence. Finally, of course, it passes into convulsions, particularly of spinal origin. It quickens respiration, through its central action on the respiratory center. Taken by mouth it stimulates secretion, and the tincture of nux has long been a staple of bitter stomachics (see page 125).

As a general tonic, and in particular as a tonic to the nervous system, in paralyses of various kinds, multiple sclerosis, the recovery from poliomyelitis and cord diseases in general, it is much used.

### 10. Drugs Used for Sepsis, Acidosis, Shock, and Anoxemia

*Liquor Sodii Chloridi Physiologicus*—U.S.X. Normal salt solution—0.85% sodium chloride in distilled water, and sterilized. Dose: see below.

*Ringer's Solution*—

| | |
|---|---|
| In a liter of distilled water: | 8.5 gm. NaCl |
| | 0.3 gm. KCl |
| | 0.2 gm. $NaHCO_3$ |
| | 0.2 gm. $CaCl_2$ |

*Glucosum*—U.S.X. Glucose. Dose: 10-30% solution. 250 c.c. for intravenous use.

*Sodii Bicarbonas*—U.S.X. See page 125.

*Oxyginum*—U.S.X. Oxygen.

*Fischer's Solution*—

| | |
|---|---|
| Crystalline sodium carbonate | 10 grams |
| Sodium chloride | 15 grams |
| Distilled water | 1 liter |

*Gentian Violet*—Not official.
*Mercurochrome-220*—Not official.

There is in this book no section on antipyretics. This has been done deliberately, because the treatment of fever, *per se,* is a relic of some other age of treatment. Fever is the reaction, probably defensive, of the body to infection. To reduce it until the infection is cured, is largely injudicious and meddlesome.

In certain infections, however, of extreme grade reaching the point of what might be called sepsis, the treatment of the accompanying shock and acidosis may be attempted and may be helpful. The evidences of shock are a rapid pulse, low blood pressure, pallor, rapid respiration, and in a more extreme grade, cyanosis, clamminess and coldness of the hands and feet, and the Hippocratic facies.

Acidosis is a condition caused by lowered ability of the blood to throw off and neutralize the acids which form in the body. The term is often used very loosely. It occurs certainly in diabetic coma and in some intestinal infections in children. Whether it occurs certainly in any other conditions we cannot be so sure. It is evidenced by red cheeks, rapid respirations, a fruity odor on the breath, acetonuria, etc. The laboratory tests for it are the hydrogen-ion concentration of the blood, and the carbon dioxide concentration of the alveolar air. Clinicians are inclined to use the term very carelessly, when shock and sepsis are present.

The conditions are widely treated by normal salt solution, by Ringer's solution, by soda bicarbonate solution and by glucose solution, either intravenously or by rectum in the form of proctoclysis.

In using sodium bicarbonate intravenously it is usually given in a 6 per cent solution, 250-1000 c.c. may be given. A solution of sodium bicarbonate cannot be boiled without converting certain amounts of it into the carbonate. However, if the sterile water or salt solution is prepared and a tin container of Squibb's sodium bicarbonate opened and the proper amount of the salt taken out with a sterile spoon, weighed on a sterile paper and added to the water or salt solution, the resulting solution will be sterile. It is important not to allow any of the solution to seep outside the vein as a slough of considerable severity will ensue.

Proctoclysis, a method popularized by Murphy for the treatment of peritonitis, consists in the continuous administration by rectum drop

by drop, of either salt solution or glucose solution, or soda bicarbonate solution. The mucosa of the rectum absorbs all of these well, salt solution best. The apparatus and technic have suffered from innumerable suggestions. The essential things are that the solution be kept warm, and that it be dropped at a regular rate. The technic is as follows:

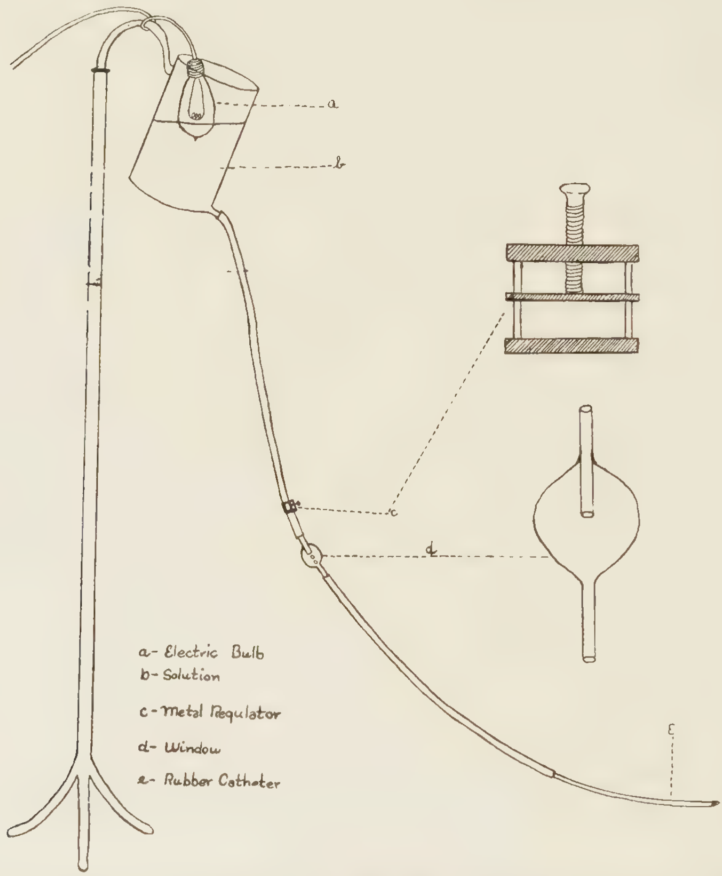



Fig. 17.—Diagram of arrangement of apparatus for proctoclysis. It is not necessary to have a vent for the escape of gas from the bowel, although this is provided for in the apparatus used in some hospitals.

1. The solution is placed in a douche can, bottle or hot water bag. The solution is kept warm by putting an electric light bulb in the can or an electric pad over the tubing as it lies on the bed.

2. The rate of flow may be controlled by a specially devised metal clip, or any one of a dozen ways of clamping the rubber tubing. It may be observed by watching a specially devised window connected in the tubing.

3. A soft rubber catheter is used for insertion into the rectum. Do not use a hard rubber nozzle or try to strap the catheter in as advised in some books.

4. The rate of flow depends somewhat upon circumstances—a drop every 15 seconds or every 30 seconds. A pint of water an hour is a large amount to give.

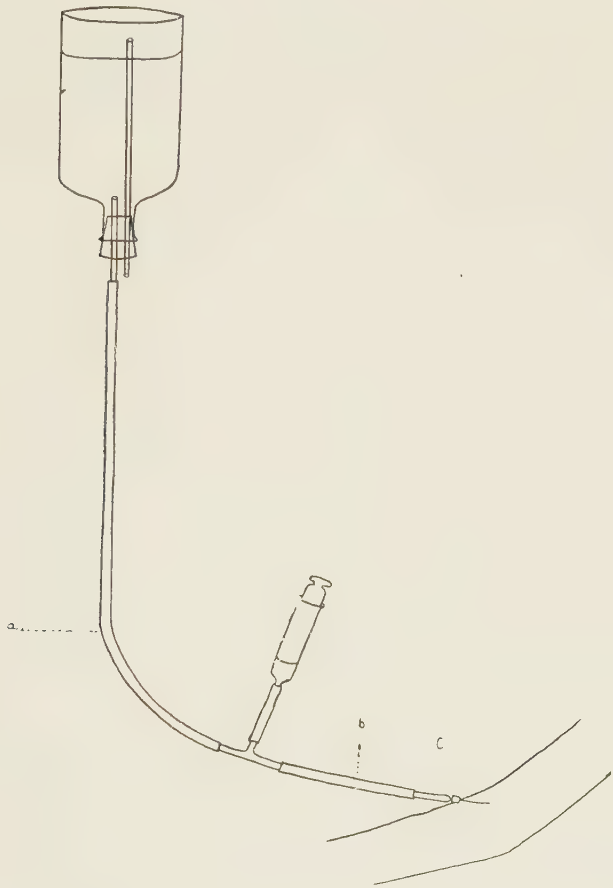



Fig. 18.—A convenient form of apparatus for intravenous administration of large amounts of fluid, either salt solution, Ringer's solution, or glucose, etc.

The solution is in the bottle: a glass tube in the two-holed cork goes to the bottom of the bottle and allows for air to enter and displace the fluid. The needle is in the vein. A three-way glass tube allows a syringe to be connected in.

*Procedure:* When the needle enters the vein, the tubing is clamped at *a*. The syringe is partially withdrawn, to see that blood comes into the glass window at *c*. The operator then knows that the needle is in the vein.

The tube is then clamped at *b* (by the fingers of a nurse or assistant) and the clamp removed at *a*. The piston of the syringe is further withdrawn until the syringe is filled. The clamp is removed at *b* and put on at *a*. The contents of the syringe is expelled into the vein. The clamp is put on at *b* again and released at *a* and the syringe again filled and so on until the bottle is empty. The use of the syringe allows of rapid administration of a large amount of fluid, with complete control of the needle (i. e., knowing it is in the vein), advantages not obtained with the ordinary apparatus without the syringe.

In peritonitis particularly, proctoclysis is of untold benefit. It gives the patient fluids but does not initiate peristalsis as fluids by mouth would. It thus reduces thirst, allows elimination, raises blood pressure, dilutes toxins. It always causes some abdominal distention. Glucose administered in this way in cases of vomiting (such as the pernicious vomiting of pregnancy) acts as a food.

Normal salt solution given in subcutaneous areolar tissue (beneath the breasts or in the thighs) or intravenously is very frequently used in surgical shock. The added volume of fluid in the general circulation raises blood pressure and tends to equalize the volume distribution of blood. Unfortunately the fluid is eliminated by the kidneys nearly as fast as it is put in. For this reason Hogan suggested the use of gelatin in the solution, and gum acacia has also been used.

Glucose solutions in sepsis, first suggested by Litchfield, have been considerably used particularly in pneumonia. Johns has done some experimental work with glucose solutions for intravenous use. He found that a 10 per cent solution in distilled water was best: below 5 per cent he got hemolysis. In normal salt solution with glucose any concentration could be used, without hemolysis. Solutions above 10 per cent are too sugary for convenience. Two hundred fifty c.c. of this solution is given at one dose. The administration of glucose to a pneumonia patient produced sleep and rest, reduced temperature, caused diuresis and diaphoresis, and slowed the heart. Chills sometimes occur: they may be due to the use of purified glucose, as traces of acetic acid are present in it: the commercial glucose is therefore preferable. The use of a small quantity of morphine in the solution often prevents them. The glucose intravenously never does any harm.

**Dyes as Antiseptics in Vivo.**—The drugs which we call specific, such as quinine, arsphenamine and ipecac, are, it is not usually noted, directed towards animal parasites. Drugs which have the property of killing *bacteria* in the living animal organism are still in a highly experimental stage. The nearest approach to success is found in the use of various dyes. It is a valuable forecast for future work along this line that the action of these dye substances appears to be selective. The ideal of accomplishment in this field is to obtain a substance which is specifically deadly for a certain bacterium and without action or at least harmless to other living tissues. Churchman, in a series of experiments, showed that gentian violet and acid fuchsin have somewhat opposite actions on gram-positive and gram-negative bacteria; that if a plate culture of both *Bacillus paratyphosus* and *Bacillus pseudo-anthracis* be exposed to a solution of gentian violet only the *Bacillus paratyphosus* will grow while if it be exposed to a solution of acid fuchsin only the *Bacillus pseudo-*

*anthracis* will grow. Major has reported on the use of gentian violet in certain cases of empyema, which work is described in the chapter on Diseases of the Respiratory System.

Mercurochrome-220 (chemically dibrom-oxymercury fluorescein) was introduced in 1919 by Young and his associates as a germicide for use in the genitourinary tract. They showed that in a solution of 1 to 1,000 it quickly killed *B. coli and Staphylococcus aureus* in urine. It is harmless in quite high concentration to human tissues, and a 1 per cent solution can be tolerated in the human bladder for three hours, and for shorter periods in the pelvis of the kidney.

Following this it was suggested that mercurochrome-220 could be used intravenously in certain septicemias such as puerperal sepsis. Later cases of general septicemia due to colon bacilli, staphylococcus septicemia, pyonephrosis, bilateral chronic pyelitis due to Bacillus lactis-aerogenous, and colon Bacillus pyelitis, were treated by intravenous injection of the drug.

The dosage for intravenous injection is 5 milligrams of mercurochrome per kilogram (about 2 pounds) of body weight. This is given in a 1 per cent solution in freshly distilled and filtered water. It is equal to 23 c.c. of a 1 per cent solution per 100 pounds of body weight. Solutions are self-sterilizing and should not be boiled. They should be made up from the scale form of the drug as the tablets are not suitable for this purpose. Reactions—an increase in temperature, vomiting, diarrhea and possibly chills—may be expected. They are often very severe.

**Oxygen.**—Various careful researches, using the arterial puncture as well as venous puncture, have shown that anoxemia, an abnormal lack of oxygen in the blood, occurs in several common clinical conditions—cardiac failure, pneumonia and emphysema. Normally the arterial blood has an oxygen saturation of about 95 per cent; in cardiac failure it may be between 95 and 75 per cent; in pneumonia between 95 and 60 per cent. Venous blood has normally an oxygen saturation of 65 to 75 per cent; in cardiac insufficiency it may be between 65 and 30 per cent. (Barach.)

Pneumonia is the disease in which it has seemed desirable to attempt to combat anoxemia by allowing the patient to breathe oxygen directly. The measurement of the oxygen saturation is a somewhat complicated technical procedure but for clinical purposes the occurrence of cyanosis may be considered the indication for oxygen therapy in pneumonia.

Disappointments in the use of oxygen for the treatment of pneumonia have, in large measure been due to the usual method of administration. By the ordinarily used tube and funnel an additional concentration of less than 2 per cent of oxygen over air is obtained. To be effective a mixture of air containing from 40 to 60 per cent oxygen is

necessary. To obtain this some sort of an apparatus must be furnished which provides an air-tight mouthpiece, connected to the oxygen tank, with a rebreathing circuit containing soda lime or some other means of absorbing the carbon dioxide. There are at least five practical apparatuses of this kind: Haldane's, which was used very extensively during the war for the treatment of gassed soldiers; Meltzer's, an oral insufflation method; Hill's which encloses the upper part of the patient in a tent; Yandell Henderson's; and Barach's. Any physician working in a hospital where a metabolism apparatus is obtainable should be able to improvise a method for delivering oxygen to the lungs in proper quantity in pneumonia.

The subject has not received the attention it deserves, and it is to be hoped that it will be developed more generally in the near future.

## 11. Antidotes

**General Antidotes.—**

*Wood Charcoal.*—Consistence of flour. Dose: unlimited quantities given in water.

*Iodide of Starch.*—It may be made quickly by adding tincture of iodine to boiled starch and may be given in almost any quantity. Use in alkaloidal poisoning, iodine forming an insoluble compound with alkaloids.

*"Universal" antidote.*—(The best general antidote for an emergency bag):

| | |
|---|---|
| Saturated solution sulphate of iron | 100 parts |
| Water | 800 " |
| Calcined magnesia | 88 " |
| Wood Charcoal | 40 " |

*Directions.*—Keep iron solution separate. Keep magnesia and charcoal in a dry state. When ready to administer, shake all together. Give a glassful at a time.

*Uses.*—This antidote renders inert arsenic preparations, zinc preparations, mercury, morphine and strychnine. It has no action on phosphorus and prussic acid.

**Special Antidotes.—**

For carbolic acid—Epsom or Glauber's salts.

For arsenic—Sesquioxide of iron. Sodium thiosulphate.

For morphine—Potassium permanganate, 10 grains to a pint of water. Atropine sulphate hypodermically.

For prussic acid—Ammonia inhalations.

For mercury—Sodium thiosulphate by mouth and intravenously. White of egg and milk.

For wood-alcohol—Iodides. Apomorphine.

For phosphorus—Copper sulphate. Liquid petrolatum.

For mushrooms—Atropine sulphate.

The treatment of acute poisonings is the one subject with which the public expects every medical man, nurse and dentist to be familiar. Yet in an experience of several years in teaching senior medical students—just about to go into practice—I have found that almost never have they received any formal instruction in, or given any thought to the matter. What they know they have usually learned from reading hastily a table of antidotes in the therapeutic manual of some drug firm. The following discussion is intended to suggest a more logical consideration of the question than such a mechanical memorizing test allows.

The substances which commonly poison the human body are arsenic, antimony, carbolic acid, opium, the hypnotics, ergot and other abortofacients, mercury, mushrooms, illuminating gas, carbon monoxide, phosphorus and prussic acid.

They may be given in order to do murder. After devoting a good deal of attention to the subject I am convinced that, from the standpoint of the murderer, poisoning is the only good way to kill a victim. DeQuincey has pronounced against it, but only from an excess of artistic emotion. Remember that when murder is done with a bullet, a knife or a hatchet, the trauma which results leaves no doubt that the victim met a violent end, whereas when poison is used there is no such evidence of supererogatory means and it must first be established that natural death did not occur, a distinct initial advantage for the poisoner before the jury. The ideal poison should have two qualities: it should be tasteless and it should leave no trace in the viscera which can afterwards be identified. Unfortunately for the profession of poisoning these qualities in combination in any one agent have not been discovered as yet. Arsenic in most of its forms is nearly tasteless. In the trial of Madelaine Smith, who was accused of putting 90 grains of arsenic trioxide in her lover's cocoa, a great deal of the time of the court was taken up questioning expert witnesses who averred that the unhappy and amorous gentleman could not have tasted the fatal dose. The poison may be disguised in case it is not in itself tasteless. This was the mode adopted, for instance, by that ingenious member of our own guild, Dr. George H. Lamson, who is distinguished in the annals of crime for having administered poison to his victim in the presence of a third party. The poison was aconitine, its taste disguised by sugar and Dundee cake.

Suicide is a second reason for the use of poison. Hypnotics and illuminating gas are favorite means to this particular end.

Accidental poisoning includes overdosage with abortofacients, and disinfectants, such as bichloride of mercury, the mistaking of one drug for another, and the ingestion of rat poison and other such substances by children or sometimes innocent adults. Rat poison, for instance, "Rough on Rats," is made up largely of arsenic.

When confronted by a case of poisoning there are always certain general methods of treatment to be carried out. These are really far more important than the specific antidotes. If the specific antidote is not immediately available in the emergency, or if the physician cannot remember what it is let him be comforted by reflecting that he is doing far more good by carrying out these general methods than anything else. These are first to clean out the gastrointestinal tract from any remaining traces of the poison; second, to dilute the poison in the blood and hasten elimination as much as possible; and third, to stimulate the general cardiovascular and respiratory functions which may be depressed by the poison. The first of these is accomplished by inducing emesis and performing gastric lavage, the second by a saline transfusion which will both dilute the poison in the blood and produce diuresis and sweating, and the third by keeping the patient warm and at rest, by a sufficiency of bed clothes and the use of hot water bottles and electric pads, and by the use of such drugs as brandy, ammonia, digitalis and hot lemonade, as well as by artificial respiration and resuscitation by the prone pressure method described in Chapter XIII.

Washing the stomach deserves a word. If the physician does not have a stomach tube at hand, let him not be discouraged. Emesis induced by making the patient stick a finger into the mouth and irritate the back of the pharynx is often more efficient than the use of a tube. In fact some years ago I was interested to review the hospital records of a series of poison cases. It was curious to find so frequently on the chart the words "Gastric lavage" followed by the notation fifteen or twenty minutes later "Copious emesis." The tube often gets clogged and equally often cannot be swallowed at all either on account of the excoriated condition of the pharynx and esophagus or the spasms and retching of the patient. In such cases, rely on the induced emesis alone. If induced emesis is performed first, the stomach tube may be used afterwards and lavage performed with tap water or a sodium bicarbonate solution. If the esophagus is too burned to permit the passage of the stomach tube, let the patient drink several glasses of water, or sodium bicarbonate solution. If the patient is too comatose to allow the induction of vomiting to be attempted, the tube comes into use. Emetics may have to be used. Easily obtained household emetics are *mustard*—

a tablespoonful to half a pint of water, and *common salt*—two tablespoonfuls to half a pint of warm water. Other emetics are *zinc sulphate*—30 grains in water, repeated as necessary, and *apomorphine*—1/10 to 1/12 of a grain hypodermically.

After emesis and gastric lavage, colonic lavage and catharsis should be instituted.

Catheterization should always be performed, unless free urination has been verified.

Chemical and pharmacologic antidotes will depend upon an exact diagnosis of the poison administered. The following diagnostic notes may be useful:

Drugs given for murder—
Arsenic, antimony, aconite, opium, strychnine.

Drugs used for suicide—
Carbolic
Opium
Oxalic acid
Rat paste
Prussic acid
Chloral
Veronal
Sugar of lead
Strychnine

Drugs used as abortofacients—
Ergot
Quinine
Diachylon plaster and lead preparations
Pennyroyal
Spanish fly

Smell of drug on breath—
Prussic acid
Laudanum
Carbolic
Ammonia
Chloroform
Paraldehyde

Mouth bleached—
Carbolic
Ammonia
Bichloride

Patient vomiting—
Arsenic
Antimony
Digitalis
Aconite
Ammonia
Phosphorus

Patient purged—
Digitalis
Bichloride

Cramping—
Lead

Patient paralyzed—
Physostiguime
Conium
Gelsemium
Aconite

Pupils dilated—
Belladonna
Hyocyamus
Opium in last stage
Alcohol
Aconite
Chloroform

Pupils contracted—
Opium
Physostigmine
Chloral
Carbolic acid

Skin moist—
Opium
Aconite
Alcohol
Tobacco

Skin dry—
Belladonna
Hyocyamus
Stramonium

Patient comatose—
Opium
Alcohol
Chloral
Chloroform

Patient collapsed—
Carbolic acid
Aconite
Arsenic
Antipyrin

Patient cyanosed—
Acetanilid
Carbolic acid
Anilin

Patient delirious—
Belladonna
Hyocyamus
Alcohol
Cannabis indica

Patient tetanized—
Strychnine
Rat poison
Antimony
Arsenic

Special methods of treatment of particular poisonings are as follows:

**Carbolic Acid or Phenol.**—For poisonous effect it is usually used in cases of suicide, largely because it is easily obtainable. In spite of almost no personal experience, I venture the opinion that it is probably

the least pleasant form of death. It burns the mouth and entire gastrointestinal tract. It is quickly absorbed and produces immediate collapse with intense and striking cyanosis. Respiratory failure causes death. In the less severe cases, rapid pulse, clammy perspiration, and the general picture of shock are notable.

Alcohol, Oils and Epsom or Glauber's salts are the antidotes. The sulphur salts form sulphocarbolates in the blood, which are harmless. They are the antidotes of choice in spite of the usually recommended alcohol. Brandy and ether may be used freely for the stimulating effect.

**Arsenic.**—The common poisonous form is the trioxide, also called white arsenic and ratsbane. It produces symptoms rapidly, within one-half hour to an hour. The first symptoms are dryness and constriction of the throat, difficulty in swallowing, and discomfort in the epigastrium. Nausea and vomiting, flocculent diarrhea, suppression of urine, dizziness, headache, pain in the muscles, collapse and coma precede death, which may occur in twenty-four hours or at least in two or three days.

The arsenic antidote by mouth is the hydroxide of iron which may be given in unlimited quantities. It oxidizes the arsenous to an arsenic compound and forms iron arsenate, which is not so readily absorbable, and if absorbed is not so readily ionized, therefore less poisonous. It must be removed by repeated lavage. Vigorous gastric and colonic lavage is regarded by Underhill as superior to all other methods of treatment in acute arsenic poisoning.

When arsphenamine or neoarsphenamine dermatitis occurs the use of sodium thiosulphate should be employed, as witness the striking results obtained by my colleagues, Drs. W. L. McBride and C. C. Dennie. Its technic in arsenic, mercury and other heavy metal poisoning is the same. It should be given by mouth as well as intravenously. Its purpose is to precipitate the metals as nontoxic insoluble sulphides. The chemical must be fresh, pure and sterile (Metz Company furnish the dry drug in air-tight sterile ampoules). In arsphenamine or neoarsphenamine dermatitis the administration is 0.3 gram of sodium thiosulphate intravenously the first day; 0.45 gram intravenously the second day; 0.6 gram intravenously the third day; 0.9 gram intravenously the fourth day; 1.2 gram intravenously the sixth day, and 1.8 gram intravenously the eighth day. Along with this 1 gram in water three times a day is given by mouth. The preparation of the solution for intravenous use is similar to the preparation of a neoarsphenamine solution. It should be filtered before using.

**Mercury** poisoning is fully treated in the chapter on intoxicants. Milk and eggs are the immediate antidotes. The chemical antidote is one of the sulphur salts, the first one used being calcium sulphide suggested by Haywood and Allen in 1913. Wilms demonstrated its effectiveness by

intravenous administration. It was recommended that it be given in a solution of one grain of calcium sulphide in one ounce of water for one grain of bichloride taken. Following the intravenous administration, three grains of calcium sulphide should be given every two hours by mouth.

Fig. 19.—Arsphenamine dermatitis.

Fig. 20.—Arsphenamine dermatitis after treatment with sodium thiosulphate.

**Morphine** or **Opium** poisoning calls for lavage of the stomach with potassium permanganate in a 1-1000 solution (10 grains to a pint, roughly). The physiologic antidote is atropine. The great danger is that the patient will fall asleep and that respiratory failure will set in. Coffee should be freely administered. Walking the patient about in the fresh air is a time-honored method of treatment.

The fatal dose of morphine is difficult to determine. In the narcotic addict it is, of course, very high. To other patients one grain is a dangerous amount, and two, three or four grains nearly always fatal. The fatal period is from one to twelve hours. If respiration can be maintained for twenty-four hours, recovery usually ensues.

**Prussic acid** is found in materials used in photography and electroplating. It is one of the most rapidly acting of poisons. It has been fatal in the dose of 1 grain (½ dram of a 2 per cent solution of hydrocyanic acid). The usual minimal fatal dose is, however, 2.4 grains. It forms after absorption with hemoglobin a stable compound, cyanhemoglobin, which action deprives the tissues of oxygen. Treatment must be prompt. Vigorous gastric lavage, ammonia inhalations and especially saline intravenous infusions with venesection are the best methods.

**Methyl-alcohol,** or **wood-alcohol,** poisoning will be found most often at present as the result of drinking impure, or bootleg, whisky. Moulton (Arkansas Medical Journal, December, 1923) warns that it is not always possible to detect wood alcohol in whisky by the smell, that bootleggers can disguise its odor and often do so. The fatal dose varies from 1 to 2 ounces, although great variations in susceptibility with different individuals occur. Blindness has occurred from taking ½ ounce. "It has been stated that if 4 ounces of wood alcohol were drunk by each of 10 persons all would have abdominal pain within three hours, four would die, two of these being blind before death, six would ultimately recover, but two of these would be blind permanently."

The treatment which we have for wood alcohol poisoning is extremely unsatisfactory. Repeated gastric and colonic lavage is the most important measure. The drug is excreted partly by way of the gastric mucosa so the lavage should be frequently repeated. Soda bicarbonate to overcome acidosis has been recommended. Venesection, saline transfusion, and induction of sweating all with the object of ridding the body of the drug are logical. The iodides have been given in large quantities. Morphine may be necessary for the pain in the eyes.

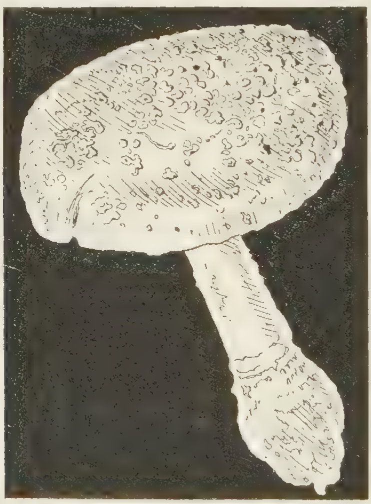
**Phosphorus** poisoning in children from chewing matches is not as common as formerly because its use as a basis for matches has been forbidden. It is still used in rat poison and may appear as a form of domestic intoxication in this way. In the treatment gastric lavage with potassium permanganate solution as in morphine poisoning should be done promptly. Potassium permanganate oxidizes phosphorus to phosphoric acid which is nontoxic. Hydrogen peroxide and copper sulphate in dilute forms are also used. The bowels should be emptied with liquid petrolatum. True fats should not be eaten for several days.

**Mushroom** poisoning is not so common as formerly because most mushrooms offered for the table are cultivated under artificial conditions.

The Amanita phalloides and the Amanita muscaria are the commonest forms of poisonous mushroom. The Amanita phalloides is white or slightly brownish. The stem is larger than the diameter of the cap, bulges at the base and arises from a sort of cup. The gills are white.

Agaricus campestris

Amanita phalloides



Amanita muscaria

Fig. 21.—Mushrooms, poisonous and edible. The Amanita phalloides and the Amanita muscaria are poisonous. The Agaricus campestris is edible.

Its poison has not been fully identified, but is probably related to indole. Amanita muscaria is a large, highly colored—yellow, orange, and red—mushroom. The gills are white. Its active principle is muscarine which is not destroyed by cooking. The antidote to muscarine is atropine.

The symptoms of phalloides poisoning are first abdominal pain, vomiting and diarrhea. Later suppression of urine, due to nephritis, and jaundice occur. The symptoms of muscaria poisoning are similar to the pharmacologic effect of muscarine—which particularly affects the nervous system. Mental confusion, dizziness, sweating, slow pulse, watery stools, rapid respiration and dyspnea, delirium and convulsions may be expected.

Treatment is directed towards elimination by gastric and colonic lavage, sweating, saline solution in the vein and supportive measures with caffeine, camphor, brandy, etc. Atropine should be given to counteract the effect of muscarine.

## References

### General

Cushny: Pharmacology and Therapeutics, Philadelphia, Lea & Febiger.
Epitome of U. S. Pharmacopeia, and National Formulary, Jour. Am. Med. Assn. Press.
Jackson: Experimental Pharmacology, St. Louis, C. V. Mosby Co.
Sollman: Text Book of Pharmacology, Philadelphia, W. B. Saunders Co.
U. S. Pharmacopeia.

### The Prescription

Eggleston: Essentials of Prescription Writing, Philadelphia, W. B. Saunders Co.
Wall: The Prescription, St. Louis, C. V. Mosby Co. This scholarly work contains a very interesting chapter on the history of the prescription and its symbols.

### Hypodermics

Macht: The History of Intravenous and Subcutaneous Administration of Drugs, Jour. Am. Med. Assn., March, 1916, lxvi, No. 12, p. 856.
Rynd: Dublin Quart. Jour. Med. Sc., 1861, xxxii, 13.

### Specific Diseases

#### *Syphilis*

Cole, Gericke, and Sollmann: The Clean Inunction Treatment with Mercury, Jour. Am. Med. Assn., December 24, 1921, lxxvii, No. 26.
Ehrlich: Berl. d. deutsch. chem. Gesellsch., 1907, xl, 3292.
Ehrlich: Ibid., 1910, xliii, 924.
Hazen: Syphilis, St. Louis, 1919, C. V. Mosby Co.
Hopkins: Antisyphilitic Action of Bismuth, Jour. Am. Med. Assn., December 26, 1924, lxxxiii, No. 28.
Jobling and Petersen: The Therapeutic Action of Iodine, Arch. Int. Med., Feb. 15, 1915, xv, No. 2.
Leredde and Jamin: Bull. de la Soc. Franc. de Dermat. et d. Syph., January, 1914.
Longcope: Jaundice Following Administration of Arsphenamine, Medical Clinics of North America, 1921, iv, No. 5.
McCafferty and MacGregor: Wasserman Fast Syphilitics Treated with Bismuth, Am. Jour. Med. Sc., July, 1925, clxx, No. 1.
Meirowsky and Kretzmer: Prakt. Ergebn. a. d. Gebeit d. Haut. u. Geschlechtsheilung, Weisbaden, 1914.
Nichols: Jour. Exper. Med., 1911, xiv, 196.
Osborne: Contributions to the Pharmacology and Therapeutics of the Iodides, Jour. Am. Med. Assn., August 19, 1922, lxxix, No. 8.
Pearce and Brown: Jour. Exper. Med., 1915, xxii, 517.
Puckner and Hilpert: Jour. Am. Med. Assn., 1910, lv, 2134.

Ricord: A Treatise on Venereal Disease, 1859.
Schamberg, Kolmer, Raiziss and Gavron: Jour. Am. Med. Assn., January 19, 1918.
Stokes and Busman: Tubing as a Cause of Reaction to Intravenous Injection, Especially of Arsphenamine, Jour. Am. Med. Assn., 1920, lxxiv, No. 15.
Stokes, Ruddeman and Lemon: Arch. Int. Med., 1920, xxvi, 521.
Stuart and Maynard: Dermatitis, Arch. Int. Med., 1920, xxvi, No. 5.

### *Parasites*

Darling and Smillie: Technic of Chenopodium Administration in Hookworm Disease, Jour. Am. Med. Assn., February, 1921, lxxvi, No. 7.
Kanter: The Intraintestinal Tube Treatment of Hookworm Infection, Jour. Am. Med. Assn., 1919, lxxiii, No. 16.
Simon: Article on Amoebic Dysentery in Tice's Practice of Medicine, Vol. VI. (A splendid, comprehensive discussion.)

### *Rheumatism*

Boots and Miller: A Study of Neocinchophen in the Treatment of Rheumatic Fever, Jour. Am. Med. Assn., March 29, 1924, lxxxii, No. 13.
Conner: Intravenous Sodium Salicylate, Med. Rec., New York, February 21, 1914.
Cooke: Allergy in Drug Idiosyncrasy, Jour. Am. Med. Assn., 1915, lxxiii, No. 10.

### *Leprosy*

Dean and Wrenshall: Jour. Am. Chem. Soc., 1920, xlii, 2626.
McDonald: The Treatment of Leprosy with the Dean Derivatives of Chaulmoogra Oil, Jour. Am. Med. Assn., November 27, 1920, lxxv, No. 22.
McDonald and Dean: The Treatment of Leprosy, Pub. Health Rep., August 20, 1920, xxxv, 1959.

## Drugs

### *Opium*

Macht: Action of Opium Alkaloids on Respiration, Jour. Pharm. and Exper. Therap., 1915, vii, 339.
Macht: Effect on Ureter, ibid, 1917, ix, 197.
Macht: On Digestive Tract, Am. Jour. Med. Sc., 1917, p. 154.

### *Antispasmodics*

Gottlieb and Meyer: Text Book of Pharmacology.
Eppinger and Hess: Vagatonia—Nervous and Mental Monographs.

### *Hypnotics*

Fischer and von Mering: Therap. d. Gegenwart., xlv, 97.

### *Digitalis*

Christian: Am. Jour. Med. Sc., May, 1919.
Cohn: Jour. Am. Med. Assn., October 30, 1915, lxv, 1527.
Cohn, Fraser and Jamison: The Influence of Digitalis on the T-Wave of the Human Electrocardiogram, Jour. Exper. Med., 1915, xxi, No. 6.
Cushny: The Therapeutics of Digitalis and Its Allies, Am. Jour. Med. Sci., April 1911, cxli, No. 4, p. 469.
Cushny: Auricular Fibrillation, Am. Jour. Med. Sc., 1911, cxli, No. 6.
Eggleston: Digitalis Dosage, Arch. Int. Med., 1915, xvi, 1.
Eggleston: Jour. Am. Med. Assn., March 13, 1920.
Eggleston: Influence of Large Doses of Digitalis and Digitoxin on the Blood Pressure in Man, Jour. Am. Med. Assn., September 22, 1917, lxix, No. 12.
Eggleston: Some Newer Concepts in Digitalis Therapy, Am. Jour. Med. Sc., November, 1920.
Eggleston and Wyckoff: Arch. Inter. Med., August, 1922, xxx, p. 133.
Gottlieb and Magnus: Arch. f. Exper. Path. u. Pharm., 1904, li, 30.

Hatcher and Brody: The Biological Standardization of Drugs, Am. Jour. Pharm., 1910, lxxxii, 360.
Mackenzie: Heart, 1911, ii, 273.
Pardee: Principles of New Method of Administering Digitalis, New York Med. Jour., December 27, 1919, cx, 1064.
Robinson: The Rapidity and Persistence of Action of Digitalis on Hearts Showing Auricular Fibrillation, Am. Jour. Med. Sc., January, 1920, clix, 121.
Schmiedeberg: Arch. f. Exper. Path. u. Pharm., xvi, 149.
Withering, Wm.: An Account of the Foxglove and Some of Its Medical Uses, with Practical Remarks on Dropsy, Birmingham, England, 1785.

### *Strophanthus*

Bickel and Pawlow: Biochem. Ztschr., 1913, xlviii, 459.

### *Squill*

White, Balboni and Vike: Clinical Observations on the Digitalis-like Action of Squill, Jour. Am. Med. Assn., October 9, 1920, lxxv, No. 15.

### *Quinidine Sulphate*

Levy: Restoration of the Normal Cardiac Mechanism in Auricular Fibrillation by Quinidine, Jour. Am. Med. Assn., May 7, 1921, lxxvi, 19.
Smith: Quinidine in the Treatment of the Cardiac Irregularities, Jour. Am. Med. Assn., March 25, 1922, lxxxviii, No. 12.

### *Novasurol and Ammonium Chloride*

Kieth, Barrier, and Whelam: Treatment of Nephritis and Edema with Calcium, Jour. Am. Med. Assn., August 30, 1924, lxxxiii, No. 9.
Idem: The Diuretic Action of Ammonium Chloride and Novasurol, Jour. Am. Med. Assn., September 12, 1925, lxxxv, No. 11.
Rowntree, Kieth, and Barrier: Novasurol in the Treatment of Ascites in Hepatic Disease, Jour. Am. Med. Assn., October 17, 1925, lxxxv, No. 16.

### *Respiratory Drugs*

John: Glucose as an Adjunct Measure in the Therapy of Pneumonia, Am. Jour. Med. Sc., October, 1920.
Smith, Eustace: Some Common Remedies, New York, 1914, Paul B. Hoeber.
Trousseau: Clinical Lectures.

### *Stomach*

Baehr and Wessler: Arch. Inter. Med., 1908, ii, 517.
Bastedo: Points in the Pharmacology of Certain Drugs Used for Stomach Effects, Am. Jour. Med. Sc., 1920, clix, 23.
Bennett: Guy's Hospital Reports, 1921, lxxi, No. 1.
Carlson: The Control of Hunger in Health and Disease, 1916.
Crohn: Am. Jour. Med. Sc., 1918, clv, 809.
Moorhead: Jour. Pharm. and Exper. Therap., December, 1915.
Palfrey: The Administration of Ox-bile in the Treatment of Hyperacidity and Duodenal Ulcer, Am. Jour. Med. Sc., 1913, cxlv, No. 6, p. 796.

### *The Cathartics*

Fantus: Useful Cathartics, Am. Med. Assn. Press, Chicago, 1920. An invaluable little book. A model for therapeutic writing.
Meltzer: The Relation of the Purgative Action of Magnesium Sulphate to Peristalsis and the General Law of Crossed Innervation, Am. Jour. Med. Sc., April, 1917, cliii, 469.
Schmidt, A.: Article on Agar-Agar, München. med. Wchnschr., October 10, 1915, lii, 1970.

### *Intestinal Antiseptics, etc.*

Plant: Action of Volatile Oils on the Intestines, Jour. Pharm. and Exper. Therap., November, 1920, xvi, 311.
Rettger and Cheplin: Bacillus Acidophilus and Its Therapeutic Application, Arch. Inter. Med., March, 1922, xxix, No. 3.
Rotch and Kendall: Study of Bacillus Acidophilus.

### *Tonics*

John: Glucose as an Adjunct Measure in the Therapy of Pneumonia, Am. Jour. Med. Sc., October, 1920.
Park and Howland: The Radiographic Evidence of the Influence of Cod-liver Oil in Rickets, Bull. Johns Hopkins Hosp., November, 1921, xxxii, No. 369.
Schabad: Ztschr. f. klin. Med., 1909, lxvii, 94. 1910.
Titus and Givens: Intravenous Injections of Glucose in Toxemia of Pregnancy, Jour. Am. Med. Assn., January 14, 1922, No. 2.

### *Oxygen*

Barach: The Therapeutic Use of Oxygen, Jour. Am. Med. Assn., August 26, 1922, lxxix, No. 9.
Barach: A Simple Apparatus for Administering Oxygen, Jour. Am. Med. Assn., February 4, 1922, lxxviii, 334.
Haldane: Therapeutic Administration of Oxygen, Brit. Med. Jour., February 10, 1917, i, 181.
Meltzer: Therapeutic Value of the Oral Insufflation of Oxygen, Jour. Am. Med. Assn., October 6, 1917, lxix, 1150.

### *Dyes as Antiseptics*

Churchman: The Anilin Dyes in Therapeutics, Jour. Am. Med. Assn., November 11, 1922, lxxix, No. 20.
Hill and Calston: Johns Hopkins Hosp. Bull., July, 1923.
Young and Hill: The Treatment of Septicemia and Local Infections, Jour. Am. Med. Assn., March 1, 1924.
Young, White and Swartz: A New Germicide for Use in the Genitourinary Tract. Mercurochrome-220. Jour. Am. Med. Assn., November 15, 1919, lxxiii, No. 20.

### *Sulphur in Heavy Metal Poisoning*

Hayward and Allen: Jour. Am. Med. Assn., 1913, lx, 1827.
McBride and Dennie: Treatment of Arsphenamine and Certain Other Metallic Poisonings, Arch. Dermat. and Syph., January, 1923, vii, p. 63.
Ravant: La Presse Méd., January, 1920.
Wilms: Jour. Lab. and Clin. Med., 1917, ii, 445.

## CHAPTER III

## BIOLOGIC THERAPY AND PROPHYLAXIS

The term biologic therapy has come to mean treatment by the use of serums, vaccines, and other products either containing bacteria (or other kinds of foreign protein which can invade the animal body such as pollens) or formed by the action of bacteria (or other proteins) on animal tissues. As prophylaxis is a more important feature of these methods than treatment they will both be considered together. The products may conveniently be classified thus: (1) antitoxins, or antisera; (2) vaccines; (3) nonspecific proteins; (4) convalescent serum. In a separate chapter we discuss the manifestations and treatment of allergy.

A knowledge of the basic facts of immunity as developed by the research of the past fifty years is necessary for a complete understanding of the uses of these products. It is not the function of a book of this kind to discuss this theoretical side; there are many good resumés of the subject to be had elsewhere, and reference is made to these. (See references: Karsner and Ecker and Hektoen.)

For our present purposes we shall point out that there are two types of immunity reaction which, so far, we can imitate by artificial means:

1. The antitoxic: the best example of this is diphtheria; the reaction consists in the neutralization of toxins by specific antitoxins.

2. The antibacterial: this process is more complex; one form of it is phagocytosis; intracellular destruction of bacteria; another form is lysis, or extracellular destruction of bacteria; agglutination takes on characteristics of several methods of destruction. The antibacterial method is the one the body uses to combat such forms of infection as the pus infections, streptococcic infection, probably typhoid, tuberculosis, pneumococcic, etc.

Each infection, however, has certain laws to itself which makes a general statement difficult and which has rendered biological therapy less generally applicable to the treatment of infectious diseases than was hoped. Our knowledge stops short at many points in the complete understanding of the very complex bacterial endotoxins and their reactions. Furthermore the very nature of certain diseases makes treatment by specific bacterial means an impracticable ideal.

For an example of both the practical and theoretical difficulties of biologic therapy let us instance the case of pneumonia. The immunity reaction in pneumonia, that is, the method the body uses of throwing

off the infection, is probably partly antibacterial and partly antitoxic. Much of the local process in the alveoli of the lungs is certainly directly antibacterial; yet this process probably prepares the way for a sudden liberation of endoantitoxins, which phenomenon is the crisis. Shall we try to stimulate the one process or the other? If we try to produce antitoxins we find that pneumonia may be due to a variety of organisms; it may be due to a pneumococcus or some other organism; if to a pneumococcus we find there are several varieties of pneumococcus; four main types, several of which have subtypes. In every individual case then we must determine exactly what variety and type of organism we have present. But, in the meantime, pneumonia runs a somewhat rapid course. Perhaps by the time we have identified our organism, the disease will be over or it will be too late. It takes a technician, with particular skill to be able to identify the exact organism, and in order that prompt attention may be given to the case, a technician must be ready to work night and day. Even so in only one type of pneumococcus, has there been found a serum with the slightest claim to antitoxic or antibacterial activity. Thus on the theoretical side, we have no method of producing an exact antiserum with the exception of one type, and on the practical side only in large hospitals in large medical centers is it possible to provide means of identifying the type of infection present, had we specific means of combating it.

It is urged at times that perhaps if we do no good by giving sera or vaccines in an infectious disease at least we do no harm. But this statement should, by no means, go unchallenged. The actions and reactions which take place in the body, after infection, between invader and host, are most complex, and it is not impossible, that the introduction of a foreign protein has actually sensitized the bacteria and made them more virulent.

These statements are made because the administration of various sera and especially vaccines prepared by commercial houses has become a very general practice in the profession. It is supposed that the preparation of these products is very difficult and very expensive; when as a matter of fact it is so simple that nearly every drug firm has taken it up. Furthermore many of the most staid of these firms make extravagant claims for these products, claims such as they would not consider making for drugs. It is not unnatural that many members of the profession, with these claims in their minds, should, when they can think of nothing else to do, administer these products in wholesale quantities.

The successes of biologic therapy have been many and brilliant. But in the face of the great expectations of the early days of bacteriologic research, there have been many disappointments.

It seems to me that it were better to acknowledge these disappointments, to refrain from the utilization of methods that repeated application has shown to be of no value. It is with that viewpoint that I have prepared the paragraphs below. In the following table I have endeavored to summarize what is, so far as I can determine, the best judgment which competent practitioners have formed on the various biologic products we have.

TABLE I

TABLE OF BIOLOGICAL PRODUCTS

| | VALUE POSITIVE | VALUE DEBATABLE OR VARIABLE | VALUE NEGATIVE |
|---|---|---|---|
| | I. SERA-(Antitoxins, antisera, etc.) | | |
| For Prevention. | 1. Tetanus serum.<br>2. Diphtheria toxin-antitoxin mixture. | 1. Antimeningococcic serum.<br>2. Antidysentery serum.<br>3. Scarlet fever toxin. | |
| For Treatment. | 1. Diphtheria antitoxin.<br>2. Antimeningococcic serum.<br>3. Scarlet fever antitoxin. | 1. Antipneumococcic serum (Type 1).<br>2. Tetanus antitoxin.<br>3. Anthrax serum.<br>4. Plague serum.<br>5. Cholera serum.<br>6. Antidysentery serum. | 1. Antistreptococcus serum. |
| | II. VACCINES | | |
| Prevention. | 1. Typhoid vaccine.<br>2. Vaccination for smallpox.<br>3. Rabies vaccination. | 1. Antiplague vaccination.<br>2. Anticholera vaccination. | 1. Influenza vaccines.<br>2. Pneumonia vaccines.<br>3. Vaccines to prevent colds.<br>4. Pertussis vaccine. |
| For Treatment. | NONE. | 1. Colon bacillus infection.<br>2. Acne.<br>3. Tuberculins.<br>4. Staphylococcus infections. | 1. Pneumococcus vaccine.<br>2. Influenza vaccine.<br>3. Gonococcus vaccine.<br>4. Streptococcus vaccine. |
| | III. CONVALESCENT SERA | | |
| Treatment. | 1. Scarlet fever.<br>2. Poliomyelitis. | 1. Measles. | |

# I. SERA

## A. Diphtheria Antitoxin

The treatment of diphtheria by a specific antitoxin was the first triumph of bacteriologic therapy. Von Behring and Wernicke in 1892 showed that the serum of animals immunized against diphtheria toxin protects other animals against the action of the toxin. Roux, in 1894,

used antitoxic serum in the treatment of human diphtheria. The conditions of infection in diphtheria are ideal for the use of an antitoxic serum; the bacilli remain in one place, and the toxins spread through the body. The toxins are quite specific, and apparently are chemically always the same so that antitoxin prepared from a strong toxin producing culture of diphtheria bacilli (Park No. 8 is usually used) can be employed and will be effective in any case of diphtheria.

**Mode of Administration.**—Diphtheria antitoxin is prepared by immunizing the horse against diphtheria toxin, and the antitoxin is therefore contained in horse serum.

The dosage is measured in units, a unit being the amount of antitoxin sufficient to neutralize one hundred times the fatal dose of toxin for a 250 gram guinea pig. No immunity is ever obtained by oral administration so that there are three alternatives in using it: subcutaneously, intramuscularly or intravenously. Being horse serum and a foreign protein the intravenous injection will produce a violent anaphylactic reaction. But there is no question that the intravenous administration will give a more rapid and more effective opportunity for neutralization of the toxin than any other method. Its use therefore should be reserved for cases of extremely severe infection or those cases seen late, and overwhelmed with toxin. Subcutaneous injection is slowly absorbed into the blood stream. "If a child weighing 25 pounds receives 10,000 units of antitoxin subcutaneously there will be a gradual accumulation of antitoxin in the blood which will reach about 1.5 units in each cubic centimeter at the end of 12 hours" (Park). An intramuscular injection is absorbed about three times as rapidly.

*For the ordinary case, then, the intramuscular injection of the antitoxin is the method of choice.*

*Rate of Elimination.*—Antitoxin remains in the body for several days. When injected intramuscularly, the highest concentration of antitoxin is in the blood, twenty-four to fifty hours afterwards. "In the case of the child of 25 pounds the blood would contain at the end of 48 hours, if given a single dose of 10,000 units subcutaneously or intramuscularly, about 4 units per cubic centimeter, and, if given intravenously, about 8 units. This persistence of the antitoxin in the blood for a number of days is not grasped by most physicians. On this misunderstanding is due the use of the multiple dose. Observations extending over years in the hospitals of New York City have added clinical to experimental evidence that a single dose is all that is required in any case." (Park.)

**Dosage.**—Park gives the accompanying table (Table II).

TABLE II

AMOUNT OF ANTITOXIN IN THE TREATMENT OF A CASE

| | MILD CASES | EARLY MODERATE | LATE MODERATE AND EARLY SEVERE* | SEVERE AND MALIGNANT |
|---|---|---|---|---|
| | Units | Units | Units | Units |
| Infants, 10 – 30 pounds in weight, under 2 years. | 2,000 – 3,000 | 3,000 – 5,000 | 5,000 – 10,000 | 7,500 – 10,000 |
| Children, 30 – 90 pounds in weight, under 15 years. | 3,000 – 4,000 | 4,000 – 10,000 | 10,000 – 15,000 | 10,000 – 20,000 |
| Adults, 90 pounds and over in weight. | 3,000 – 5,000 | 5,000 – 10,000 | 10,000 – 20,000 | 20,000 – 50,000 |
| Method of administration advised. | Intramuscular | Intramuscular | Intravenous | Intravenous |

*When given intravenously, the smaller amounts stated.

## B. Diphtheria Prophylaxis

**Schick Test.**—By the use of the intradermal injection of very small amounts of diphtheria toxin, the Schick test, it has become possible to determine whether or not any given individual is susceptible or immune to diphtheria.

The technic of the test is simple. A small amount—from 0.1 to 0.2 c.c.—of physiologic salt solution, containing $\frac{1}{50}$ M.L.D. (minimal lethal dose) of toxin for a 250 gram guinea pig is injected with a fine needle into the dermis (not under the skin); for this purpose a tuberculin syringe should be used, as accurate dosage can be accomplished; the bevel of the needle should be pointed upwards, and, when it is properly placed, can be seen through the epidermis; the injection should raise a small whitened papule in the skin, pitted by hair follicles.

Nearly all drug firms now have Schick test outfits on the market. These supply both the proper amount of toxin and of physiologic salt solution. As the toxin is very unstable in solution the dilution must be made just before use.

The test, if positive, shows in twenty-four or forty-eight hours, as an area of redness, two or more centimeters in diameter. This means that the individual is susceptible to diphtheria; that he has not sufficient antitoxin in his body to neutralize the toxin. When the individual is immune—when there *is* enough antitoxin in his body to neutralize the toxin—no reaction appears, and the test is negative.

The positive reaction lasts from seven to fourteen days, gradually fading, and leaving some scaling and pigmentation.

"It is important to distinguish the true reaction from a pseudoreaction which is only found in a small percentage of older children and

adults, who may have a large amount of antitoxin. These reactions are probably local sensitization phenomena of a general protein character, since similar reactions can be obtained with dilutions of nutrient broth or peptone solution in the same percentage as in the toxin dilution or a dialysate of the Klebs-Loeffler bacillus. The pseudoreaction can be distinguished clinically by the trained observer in practically all cases from the true reaction. It appears earlier, is more infiltrated, less sharply circumscribed and disappears in twenty-four to forty-eight hours. It leaves only a faintly pigmented area, which, in our experience, never shows superficial scaling.

"Though the intensity of the reaction varies in different individuals, a well-marked redness indicates an almost complete absence of antitoxin. Faint reactions point to the presence of very small amounts of antitoxin, which are not sufficient, however, to certainly protect the individual against diphtheria. To prevent the appearance of the reaction, according to Schick, at least 1:30 unit of antitoxin per mil (c.c.) of blood is required. This amount he considers sufficient to protect against diphtheria." (Park, Zingher and Serota.)

In practice, it has been found that susceptibility to diphtheria as shown by the Schick test occurs in about 15 per cent of all individuals up to the age of three months, the percentage increases steadily from that age on to one year when it is 60 per cent of all individuals, remains at about that figure until the age of three years, after which it begins to decline, being 40 per cent at five years, 30 per cent at ten years, and 12 per cent over twenty years.

**Active and Passive Immunization of Susceptible Individuals.**—When a Schick test is positive in an individual, we are able to confer either a short immunity on him, or a permanent immunity, or both.

The short, passive immunity is conferred by the use of 1,000 units of diphtheria antitoxin given intramuscularly. It lasts from 10 to 21 days. A repetition of the dose at the end of that period confers an immunity of a yet shorter period—for six or seven days. When passive immunity is conferred in this way, the physician must consider the possibility of the sensitization of the patient to horse serum, and if another injection becomes necessary anaphylactic phenomena may supervene.

Permanent active immunity can be given by (1) *the subcutaneous injection* of (2) 0.5 c.c. (for children under one year) to 1 c.c. of (3) diphtheria toxin-antitoxin mixture (a preparation of these two bodies in such proportion that they are practically neutralized), (4) at weekly intervals, (5) for three doses.

The immunity conferred by this method begins in from five to seven weeks after the last injection, and lasts for years, and for all we know to the contrary, for life.

The statements made above have each been ascertained after long and painstaking clinical research, largely by Dr. William H. Park and his associates in New York. The question, for instance, of giving one, two or three injections of the toxin-antitoxin mixture was determined separately and exactly. It would be tempting to quote at length from these experiments as they are models of the careful work upon which clinical medicine rests, but space forbids. We can only refer those interested to the literature and state, as we did above, the results of the work which has already become an integral part of practice.

Which form of immunity to use will depend upon circumstances. In the presence of contact with an actual case of diphtheria, passive immunity with the antitoxin and later, the use of the toxin-antitoxin mixture should be used. If children are to be immunized to diphtheria as they are to smallpox, the toxin-antitoxin mixture should be administered at the age of six to twelve months.

### C. Antimeningitis Serum

Several antimeningococcic sera have been introduced but the most effective one, and the one now generally used, is Flexner's, first used in the epidemic of cerebrospinal meningitis at Akron, Ohio, in 1907. The figures which demonstrate its value are given in another place; suffice it to say here that when properly prepared it is unquestionably of the greatest value in epidemic meningitis due to the diplococcus of Weichselbaum.

It is prepared by immunizing the horse against several strains of this bacterium. This feature resulting in the preparation of a polyvalent serum is one that is strongly emphasized by Flexner. There are several strains of the meningococcus and the serum must contain a high titer to all the fixed types and available intermediates. It is this which makes the preparation of antimeningococcus serum a much more difficult process than that of diphtheria or tetanus antitoxin, the manufacture of which is comparatively simple. To reduce the preparation of polyvalent meningococcus serum to a routine is to endanger the efficiency of the product. The practitioner must always be on the alert for this, and if his results in a meningitis case, with serum, are not immediately good, he should suspect the serum he is using and change to a different brand.

The serum is antibacterial in its action, not antitoxic. Its first effect is to injure the meningococci, which become reduced in number and

altered in size and staining properties and are taken up by the leucocytes in greater numbers. It also increases the number of leucocytes in the spinal fluid, so that the second tapping may show a more cloudy fluid than the first.

**Mode of Administration and Dosage.**—With an exception to be noted below the effective method of giving the serum is intraspinally. The following rule for a suspected case should be carried out:

1. A tube of 30 c.c. of polyvalent antimeningococcus serum should be at hand warmed.

2. Lumbar puncture is done.

3. If the fluid is cloudy, the serum should be given intraspinally, without further (bacteriologic) examination of the spinal fluid.

4. At least 30 c.c. of fluid are removed.

5. Thirty c.c. of serum are given intraspinally by gravity, slowly. This dosage is for an adult. Suitable variation may be made for children.

6. If bacteriologic examination proves the diplococcus intracellularis meningitides to be present, lumbar puncture, with withdrawal of 30 c.c. of fluid and replacement of 30 c.c. of serum is done every twenty-four hours, until recovery is assured, or the patient is dead.

7. Four to six administrations of the serum are usually sufficient.

Herrick, observing an epidemic in military practice, advises the use of the serum intravenously, because he believes the infection is a blood stream infection first, the infection of the cerebrospinal axis occurring secondarily. Personally I am not in entire agreement with this view, as I believe that Herrick's experience was special, and that all epidemics are not of this character, but there are undoubtedly cases in which intravenous, as well as intraspinal administration of the serum is advisable.

From 30 to 100 c.c. of the serum may be given intravenously. An anaphylactic reaction is almost certain to occur. Desensitization by a preliminary dose of 1 c.c. intravenously should be done, and an hour later the administration of the serum begun, and continued very slowly, the first 15 c.c. being given at the rate of 1 c.c. per minute. If alarming symptoms develop 1 c.c. of a $1/_{1,000}$ solution of epinephrin chloride, and $1/_{100}$ grain atropine should be given hypodermically.

### D. Tetanus Antitoxin

The Bacillus tetanus, when grown on broth, will produce two toxins, one, tetanolysin which is actively hemolytic, and another tetanospasmin which is capable of producing the symptoms of tetanus. It is possible,

by precipitating the tetanolysin with red blood corpuscles to separate the tetanospasmin and observe its effect, and to immunize against it separately, but in practice the antitoxin is produced as a whole, without separation of the two toxins. It is produced for commercial purposes in the horse. The antitoxic unit is ten times the amount of antitoxin necessary to protect a guinea pig against 100 minimum lethal doses.

Its chief value is for prophylactic purposes. Infection with the bacillus tetanus usually occurs in wounds; the bacillus remains in the site of the wound, the toxin spreading up the nerve sheaths until it reaches the spinal cord and higher centers, where it makes a firm chemical union with gray nerve tissue. (Zupnik denies the neural route of absorption of tetanus toxin and believes that it travels in the blood stream; Meyer and Ransom believe it follows both routes). The important practical feature about this is that after the toxin is bound to central nervous tissue the antitoxic serum is not in most cases efficient to break it up. It must therefore be given early.

In every case of open wound in which there is extensive laceration of tissue; of punctured wounds, by nails, sea shells and so forth; of bullet wounds, blank cartridge wounds, Fourth of July injuries, or wounds in which street dirt or barnyard or garden soil can enter, 1,000 units of tetanus antitoxin (500 units in children) should be immediately given subcutaneously, preferably in the same extremity and distal to the wound. The wound should also be treated surgically. If the wound continues to slough or suppurate, the dose should be repeated, one week later, and possibly a third time.

The effectiveness of this treatment, in the prevention of tetanus has been demonstrated many times, by the most convincing comparative tables of statistics. Thus, in the World War, Wolff reports that in the German Army, prophylactic doses of serum were not given as a routine prior to December, 1914, and that the incidence of tetanus among the wounded was 1.4 per cent; during the next seven months, when the serum was given as a routine to those wounded by shrapnel and hand grenades, the incidence of tetanus was 0.16 per cent. The most conclusive group of statistics, however, is probably that of the United States in civil practice, with the Fourth of July injuries. In 1903, the *Journal of the American Medical Association* began a vigorous campaign to encourage the use of antitetanic serum for wounds due to the explosion of firearms, cannons, firecrackers, etc. The campaign was effective and Table III shows the results.

In a few instances, the antitoxin fails to prevent tetanus. The consideration of the probable reasons it does so are illuminating to our

TABLE III

| YEAR: | TOTAL INJURED: | TETANUS CASES: | PER CENT OF TETANUS CASES: | DEATHS FROM TETANUS | TETANUS MORTALITY PER CENT |
|---|---|---|---|---|---|
| 1903 | 4449 | 415 | 9.35 | 406 | 97.8 |
| 1904 | 4169 | 111 | 2.52 | 87 | 78.4 |
| 1905 | 5176 | 104 | 2.01 | 87 | 84.0 |
| 1906 | 5466 | 89 | 1.45 | 75 | 84.0 |
| 1907 | 4413 | 73 | 1.65 | 62 | 84.0 |
| 1908 | 5623 | 76 | 1.35 | 55 | 72.4 |
| 1909 | 5307 | 150 | 2.82 | 125 | 83.2 |
| 1910 | 2923 | 72 | 2.46 | 67 | 93.0 |
| 1911 | 1603 | 18 | 1.12 | 10 | 55.5 |
| 1912 | 988 | 7 | 0.71 | 6 | 86.0 |
| 1913 | 1163 | 4 | 0.35 | 3 | 75.0 |
| 1914 | 1506 | 3 | 0.2 | 3 | 100.0 |

knowledge of the action of the antitoxin, and a guide to practice. They have been well analyzed by Robertson.

The first reason is the too rapid formation and absorption of the toxin. Kitasato inoculated the tails of mice with tetanus bacilli and cut off the tails at varying intervals. This removed the source of toxin production. He found that in order to prevent the development of tetanus it was a matter of minutes rather than hours. If he cut off the tail at the end of an hour, the mouse invariably died of tetanus. Tetanus antitoxin then cannot be given too soon after a wound has been inflicted.

Secondly the antitoxin may not be absorbed sufficiently rapidly to detoxicate the patient. The antitoxin reaches its maximum concentration according to Kuon, in twenty-four to forty hours after administration.

Thirdly, a very important consideration is that the single dose of antitoxin may confer a short immunity and then be used up while the infection continues. For this reason it is well to regard, with care, the directions given above, for the administration of the serum—that a second and even a third dose are desirable if the wound shows signs of continued infection. Various experiments are on record tending to show the period during which passive immunity is conferred from a single dose, the consensus of opinion being about 14 days.

As a last reason may be given the method of use of the antitoxin. Calmette in 1903, introduced a dried powder of tetanus antitoxin which he recommended to be powdered over the wound. In many cases in which it has been used it has proved unsuccessful.

*Treatment of established tetanus* by the antitoxin has not been so successful, for reasons that are inherent in the nature of the disease. The cause of the symptoms and of death in tetanus is, as has been said above, the firm binding of tetanus toxin to the tissue of the central nervous

system. The affinity between these two is stronger than the affinity between toxin and antitoxin, and the presence of the antitoxin does not break it up.

The best method of administering the serum is intraspinally. Three thousand to 5,000 units are given by gravity after the withdrawal of a proper amount of spinal fluid; the serum may be diluted with salt solution, or not, as desired. It is well to give also 10,000 to 15,000 units intravenously. This does not constitute the sole method of the treatment of tetanus, however, though it should not be omitted. I have heard it said that the administration of the serum intraspinally is contraindicated because it causes death. This is a stupid criticism; if death occurs it is due to the tetanus, not the serum.

### E. Antistreptococcus Serum—Erysipelas Serum

Antistreptococcus serum has not been very successful in the treatment of infections, largely due to the great variety of streptococci and their peculiar immunologic reactions.

For erysipelas the most successful serum is that prepared by Birkhaug in 1926 by the immunization of horses to different strains of organisms found in erysipelas cases and to subcutaneous injections of gradually increasing amounts of erysipelas toxin. The serum as prepared is put up in ampoules of 10 c.c. and 25 c.c. size, concentrated and unconcentrated. It is administered best intramuscularly. Intravenously if the case is urgent, but only as a last resort on account of the reaction. Early and adequate dosage is emphasized. Symmers reports 92.1 per cent of cures in 563 cases of facial erysipelas, in from two to seven days.

### F. Antipneumococcus Serum

The only antipneumococcic serum worth considering at all is that produced by Cole and his coworkers for Type I pneumococci. They found that there were three fixed types of pneumococci, Type I, Type II, Type III, with specific immunologic reactions. There were many other variable strains, classified as Type IV. After considerable experimentation, they came to the conclusion that sera prepared against Types II and III were therapeutically ineffective. On account of the variability in the strains of Type IV no immune serum of this class can be prepared.

Serum of horses immunized against Type I pneumococci was prepared and after using it in 195 cases with a mortality of 9.2 per cent, Cole and his coworkers concluded that it had great therapeutic usefulness.

The technic of the procedure necessitates first the determination of the type of pneumococcus present in the patient to be treated. This is done by collecting the sputum, injecting it into the peritoneal cavity of a white mouse, and precipitating the peritoneal washings of the mouse, after death, against the three fixed types of antisera. (Avery has described a method of type determination which obviates the use of white mice.)

If Type I pneumococci are demonstrated, the patient is immediately given 90 to 100 c.c. of the serum, intravenously after first being desensitized. The dose should be repeated every eight hours until the patient is on the way to recovery.

Cole and his colleagues deserve a great deal of credit for the valuable work they have done in adding to our knowledge of the immunity reactions of the pneumococci, but—and naturally this is added with regret—clinical results have not confirmed their therapeutic claims. The technic required is so special that only in a few favored spots could it be carried out, at the present time. This could be arranged, however, if the success of the method justified it. The concensus of clinical opinion seems to be that it does not. I observed its use in over 300 cases, and while statistically there was a slight difference for the better in the cases which received the serum over those which did not, it is not possible to say that any change due to the serum, could be observed in the clinical condition of the patients as they were seen hour by hour, and day by day. There is not seen any such unquestionable improvement as that which follows the use of undoubtedly specific sera, such as diphtheria antitoxin or antimeningitis serum. And clinically pneumonia varies so widely in different epidemics, and in the same epidemic in different localities, as to make its statistics the most unreliable of all such data.

### G. Antianthrax Serum

In 1895 both Marchoux in France and Sclavo in Italy published accounts of the use of an antianthrax serum, made by the inoculation of animals with attenuated anthrax bacilli. Eichhorn, Berg and Kesler of the Bureau of Animal Industry, have produced (1915) an antianthrax serum, which is both safer and more effective than the former ones; they immunize with a combination of potent anthrax serum and carefully standardized spore vaccine.

Regan is a strong advocate of the use of the serum without other treatment. The important thing in anthrax is to prevent the bacilli from getting from the local cutaneous lesion to the blood stream; when a general septicemia and consequent hemorrhagic meningitis has occurred

there is usually little chance of cure. Regan therefore advises the use of serum locally into the pustule itself. By this means he believes the highest efficiency is obtained at the site of the greatest concentration of infection. He gives 2, 2.5 or 3 c.c. of the Eichhorn serum at each of three or four points at various sides of the pustule: "the needle is inserted into the red indurated border of the pustule just beyond the blanched zone."

For general administration 50 c.c. of the serum may be given, every twelve to twenty-four hours, usually not more than four injections being necessary. The first two injections are recommended to be given intravenously, the rest intramuscularly.

In septicemic cases Eichhorn advises giving 200 to 300 c.c. of the serum intravenously every three to six hours.

In a small epidemic of anthrax seen in army practice at Fort Sam Houston, Texas, our results were very good with cauterization—removal of the pustule and simultaneous intramuscular administration of anti-anthrax serum.

### H. Antidysentery Serum

Sera prepared both for the Shiga and Flexner variety of bacillus dysenteriæ have been used with improvement in clinical results. The average dose of the serum for an adult is 20 c.c., for a child 10 c.c. It is usually given subcutaneously, but in severe cases may be given intravenously. It may be given in doses as high as 100 c.c.

**Prophylactic Use.**—Polyvalent antidysentery serum 5 c.c. subcutaneously is said to protect for twelve to fourteen days.

The results have not been confirmed on a large scale, and epidemics of dysentery vary in mortality so widely that such confirmation must take this factor into account.

### I. Antibotulinus Serum

The serum which is polyvalent, made of mixed A and B (and recently added C) strains of the bacillus, is reported to be absolutely specific. It should be given intravenously, as soon as possible, on account of the rapidly fulminating character of the symptoms, as much as 10,000 to 20,000 units to a dose.

### J. Anticholera Serum

The antitoxin of Kraus has been used most extensively; it is given intravenously 140 c.c. of serum to 500 c.c. of salt solution, and repeated 24 hours later with a smaller dosage. Carrière and Tomarkin's serum, (50 c.c. to 100 c.c. intravenously and subcutaneously) was found more

effective in some epidemics. Reports vary as to the effectiveness of these sera, both therapeutically and prophylactically.

The cholera vaccine for prophylactic purposes made at the government laboratory at Bombay contains 8,000,000,000 organisms per c.c., 0.5 is given subcutaneously at the first dose, and 1 c.c. at the second dose, a week later. The reaction is mild. It offers, according to reliable reports, a good but not absolute degree of protection for three months, possibly six.

### K. Antiplague Serum

Yersin's serum was prepared by injecting horses first with dead, then with living, plague bacilli. Opinions differ as to its value. Kraus' serum was prepared by immunizing horses with dead bacilli and nucleoproteins. In extensive practice Kraus' serum seems to give fair results, reducing the mortality from 12.5 per cent to 7.8 per cent.

Prophylaxis with Haffkine's vaccine, according to the Indian Plague Commission, diminishes the incidence but does not absolutely protect. Other reports seem to indicate that it reduces both incidence and mortality considerably. One, sometimes two, doses are given.

## I. SCARLET FEVER ANTITOXIN

Work reported since the first edition of this book was published establishes the etiologic factors in scarlet fever and provides a method of specific diagnosis of the disease, a specific antitoxin and means of recognizing immune and susceptible individuals, as well as methods of immunizing the susceptibles. The skin test for testing suspects does not appear to be as unexceptionably final as the similar method of testing diphtheria suspects, nor is there full agreement as to the immunity-conveying powers of the toxin, but enough work has accumulated to make its use recommended.

The hemolytic streptococcus was for many years suspected of implication in scarlet fever, on account of its persistent presence in the throats of scarlet fever patients and in the secondary complications such as otitis media, pneumonia and septicemia. Hemolytic streptococcus, however, is the family name of a large variety of organisms. Dochez, a few years ago, developed a method of differentiating the various strains of the germ. Dochez finally demonstrated a particular type found in the throats of scarlet fever patients. Dick and Dick, using this organism, produced a filterable toxin after growing it in broth. The toxin gives a skin test neutralizable with convalescent serum. After many attempts to produce scarlet fever in animals, which attempts were beset with difficulties, Dick and Dick obtained some human volunteers. In a first

series of subjects inoculations were made with fresh whole blood and fresh blood serum from acute cases of scarlet fever, and with filtered throat mucus from early cases. These were negative. In a second series volunteers were inoculated with a culture of the Dochez organism after its isolation from scarlet fever patients. In none of these subjects was clinical scarlet fever produced. In a third series five volunteers were inoculated with organisms obtained from pus from the infected finger of a nurse whose infection arose from the handling of a scarlet fever patient; in one of these volunteers, in 1923, a typical clinical case of scarlet fever was produced. It was still necessary to learn whether the experimental scarlet fever had been produced by the hemolytic streptococcus or by a filterable virus associated with it in the culture. A second group of volunteers was inoculated with a culture of the same organism after it had been passed through a Berkefeld "V" filter. These volunteers remained well. After two weeks had elapsed and they were still well, they were inoculated with the unfiltered culture. Forty-eight hours later one of them developed scarlet fever. This experiment furnished evidence that the disease was not caused by a filterable virus but was due to the hemolytic streptococcus itself.

In the course of their studies, Dick and Dick found that by using the toxin produced by growing the streptococcus in broth they could produce a skin reaction in susceptible individuals who had never had scarlet fever, similar to the Schick reaction in diphtheria. One-tenth c.c. of scarlet fever toxin in dilution is injected intradermally into the arm, using heated toxin in the other arm as a control. A positive reaction—a reddened spot on the skin—appears in twenty-four hours, and lasts less than four days. This is different from the Schick test which is read on the fourth day. On account of this early fading of the Dick test some confusion has arisen, and altogether it is neither so satisfactory nor so reliable as the Schick test. Not only may false positives be obtained by the serum producing a nonspecific serum reaction (a thing which is eliminated in the Schick test, as no nonspecific protein reaction lasts four days), but one negative reaction does not seem to indicate immunity. In a small epidemic in a fraternity house in a college town, in which all the people exposed to the disease and actually living in the house with the patients were tested, Sherwood found 5 positive or susceptible individuals by the Dick test, and yet every one of these had been living or boarding in the house with scarlet fever patients without getting the disease.

Dochez showed that the blood of patients who had just recovered from scarlet fever contained a large amount of antitoxin. In 1918 Scultz and Charlton demonstrated a diagnostic test for scarlet fever by injecting 1 c.c. of serum from a convalescent scarlet fever patient into the skin of

an active case. If it is a true case of scarlet fever, a blanching of the rash at the site of injection occurs. This test, which has diagnostic value, indicates that the rash is produced by the toxin and when this toxin is neutralized the rash fades. Dochez produced a scarlet fever antitoxin by immunizing horses. This serum of Dochez's has been extensively tried out by Blake and shown to have marked curative value. It must be used early in the disease. It appears to prevent complications, but has no effect on them after they are established. The dosage is measured in units, one unit being the amount which will neutralize 100 skin-test doses of toxin. The dose for treating clinical scarlet fever is 2,000 to 10,000 units. It may be given intramuscularly or intravenously. The intramuscular injection is somewhat slower in action, though definite results can be seen in twelve hours; it is freed from the disagreeable effects of serum rash obtained by intravenous injection. A single intramuscular dose of 5,000 units is the usual average in early cases of moderate severity. This has been followed by complete relief of the clinical signs in twenty-four hours. In very toxic cases higher doses should be used or intravenous administration of a smaller amount.

The immediate good results following antitoxin administration consist in alleviation of the sore throat, fall in temperature and pulse, cessation of vomiting, and clearing of the intellect.

Active immunization is produced by the scarlet fever toxin.

The amount of toxin to be used is measured in skin-test doses. In children under twelve years three hypodermic injections of 100, 250 and 250 skin-test doses are given at weekly intervals. For persons over twelve years of age the amounts may be 100, 250 and 500, or even 1,000 skin-test doses. Local reactions at the site of injection may be expected. The degree or certainty of the immunity thus conferred has not been settled finally by health officers and immunologists.

## II. VACCINES

There was a saying of Huxley's that "the greatest tragedy in the world is a beautiful theory killed by an ugly little fact."

This particular drama has been enacted many times in the history of therapeutics, but in no instance so poignantly as in the case of the vaccines. The theory was so beautiful; the fact that they did not do one tithe of what was expected of them was so brutal. That they are still used far more than they should be is due, I believe, to two things. One is the ceaseless activity of interested manufacturers of stock vaccines. One firm has issued a book devoted alone to praise of the virtues of stock vaccines. It is filled with case reports, purporting to show the value of

vaccines in such things as appendicitis, endocarditis, tonsillitis, pneumonia, influenza, acute bronchitis, pruritus ani, nephritis, ulcer of the stomach, skin diseases of all kinds—in fact to nearly every known form of pathology except tumors. In most cases it has been abundantly demonstrated that the treatment is of no value; and in many diseases, the administration of vaccines prevents the carrying out of measures that are distinctly curative.

But all this makes an appeal to a certain type of practitioner. It saves thought. The process is so simple. The doctor asks the patient what the matter is, and the patient replies that he has bronchitis. The doctor consults his list and finds under B. that bronchitis vaccine is No. 39, which he administers according to the directions. The patient recovers and speaks highly of the use of vaccines.

It should be stated in the most emphatic terms that the use of stock vaccines, with one exception, is utterly without scientific or practical foundation. That exception is typhoid-paratyphoid vaccine for preventive purposes, or for therapeutic purposes, as nonspecific protein. In fact stock vaccines are nothing but nonspecific proteins. Being particular to have a large variety and to choose a tonsillitis vaccine for tonsillitis is nothing short of ridiculous.

Let us go back to the theory. Sir Almoth Wright was largely responsible for the details. Metchnikoff had established the fact that certain bacteria were destroyed in the body by the mechanism of phagocytosis or the ingestion of the bacteria by the leucocytes and other body cells. Wright showed that there was a substance developed in the blood of immunized animals which rendered the bacteria easier of ingestion. This substance he named *Opsonin.* He devised a clinical test to show what he called the opsonic index of a patient's serum, using a stable group of leucocytes and a stable bacterium. As the opsonic index varied so did the patient's resistance to infection. When a particular infection was present in the patient's body, the injection of killed bacteria caused the opsonic index to rise, so that phagocytosis was increased for a few days, then the index went down and a reinjection was necessary to stimulate the opsonic index to another rise. Wright particularly pointed out that it was detrimental to inject the vaccine during a down wave of the index, and demanded frequent examination of the blood in order to have the vaccine given on the up grade of the wave.

Thus the beautiful theory stood, that in a chronic infection, the patient's opsonic index was usually not high enough to completely destroy the invading bacteria, but that by the injection of dead bacteria in the

form of vaccines, the specific opsonins to that infection would be increased, and complete immunity would be established.

What were the ugly facts which killed this beautiful theory? The important one was that, in actual practice, the vaccines, by no means, were as valuable as had been hoped. Secondly, it was found that any protein material, injected intravenously would do as well as the specific vaccines. Thirdly, for most chronic infections, the invading organisms intrench themselves in tissue spaces and are ready to create a reinfection at any time; and supplementary to this the opsonic immunity is very transitory, and may be very low at the time this reinfection occurs.

From the welter of innumerable experiments in practically every infectious disease, performed by clinicians and bacteriologists over the entire world, certain positive and certain negative results have come about.

First, the use of vaccines in acute self-limited infections has been repeatedly demonstrated to be of no value, and is probably distinctly detrimental to the patient's interests. One vaccine manufacturer's statement to the effect that in acute infections it is necessary to give very large doses of vaccines, is utterly unproved.

Second, the place of vaccines is in chronic or subacute infections, which cannot be cleaned out surgically. Sometimes they are a useful adjunct to surgery. Even here, in chronic cases they have not been so successful as we were led to hope they would be. In no instance can the patient be assured that they will be certainly successful; although at times they appear to act very well. In certain cases they are particularly valuable, to wit:

### A. Colon Bacillus Vaccine

*In colon bacillus infection*, especially of the pelvis of the kidney, autogenous vaccines in the dosage of 10 to 25 millions for a beginning and increasing in strength until 1000 million are given. Some patients can never stand the very high doses.

### B. Acne Vaccine

*In indurated acne* an autogenous vaccine made from the pus of several acne pustules, in dosage of 3 to 5 million every five to seven days is recommended. The B. acne should be cultivated by special means, and local measures such as expression of comedones, incision of pustules, etc., also employed. Only in those forms of acne, which are indurated or cystic, is the use of vaccine hopeful.

### C. Asthma, Chronic Respiratory Infections and Hay Fever Vaccine

*In asthma, hay fever and other allergic phenomena,* the injection of responsible bacterial or pollen proteins is valuable in certain cases. Here, however, the mechanism is somewhat different. In chronic respiratory diseases—chronic bronchitis, early bronchiectasis, and infections of the bronchial mucosa from chronic nasal infection—autogenous vaccines have proved valuable in my hands.

### D. Cholecystitis

*In cholecystitis,* in which the organisms used have been obtained by direct drainage from the gall bladder by the method of Lyon, good results have been obtained when other methods, including surgery, have failed.

### E. Typhoid and Paratyphoid Vaccine

The great body of literature upon the *prevention of typhoid and paratyphoid fevers with vaccine* can be summarized very briefly. Typhoid and paratyphoid fevers can be prevented by the use of the subcutaneous injection of killed bacilli. The immunity so incurred lasts a variable time in different individuals, but on the average about three years.

During the war some cases of typhoid occurred among vaccinated troops six months after the inoculation; but in most of these cases it was found that the vaccinations had not been completed. There is some evidence to show that the immunity is very active for only one year. Troops, and other migratory bodies of men, such as railroad gangs, should perhaps be revaccinated oftener than those less likely to be exposed. Revaccination should be done when trips to Europe, the tropics or the wilds are contemplated. The injections are without danger and should be administered to every person as regularly as is smallpox vaccination, at the age of about two or three years. Children stand them better than adults. The data in favor of these conclusions has been collected repeatedly, by many different observers, and is beyond dispute. A sample of the statistics is as follows:

In 1898, the Seventh Army Corps at Jacksonville, Florida, had a strength of 10,759 men. No antityphoid vaccination was carried out. Forty-one per cent of the men acquired typhoid fever.

In 1912, at San Antonio, Texas, of 12,801 men in the army mobilization, all were given antityphoid vaccination. No case of typhoid fever developed.

During the World War, under conditions of universal antityphoid vaccination there was one case of typhoid fever to every 3,756 men in

the army of the United States. During the Spanish American War, when no antityphoid vaccination was carried out, there was one case to every 7 men, in the army of the United States.

**Technic.**—The vaccine is prepared by growing typhoid and paratyphoid bacilli in broth and killing, usually by heat. The vaccine is given subcutaneously in three doses, given from 7 to 10 days apart. Shorter intervals, while there is no particular contraindication to them, do not confer so lasting an immunity. The single dose of bacilli in oil, so-called lipovaccine, has been discarded, because it does not furnish sufficiently high agglutinative titer in the blood.

| | |
|---|---|
| The first dose contains: | (1) 500,000,000 typhoid bacilli |
| | (2) 250,000,000 paratyphoid bacilli A. |
| | (3) 250,000,000 paratyphoid bacilli B. |
| The second and third doses contain: | (1) 1,000,000,000 typhoid bacilli |
| | (2) 500,000,000 paratyphoid bacilli |
| | (3) 500,000,000 paratyphoid bacilli |

The reaction following any injection may vary in severity up to a febrile reaction consisting of a chill and temperature of 104° F. Some local tenderness is the rule: abscesses may form.

## F. Antirabic Vaccination

The prevention of rabies is accomplished by active immunization with fixed rabies virus, after a suspicious inoculation, i.e., the bite of a rabid animal, has occurred. The usually long incubation period of rabies makes this feasible.

Fixed virus of rabies is made from the virus as found in nature (street virus) by serial passage through a number of nonresistant animals, the rabbit being commonly used. This is "the one fundamental and essential step in the preparation of rabies vaccine." The actual preparation of the vaccine for use is of secondary importance, as several methods are used with equally good results. Passage through animals results in a change in the properties of the street virus, as seen in a shortening in the incubation period of the disease, and the development of a paralytic rather than convulsive form of the disease. The virus is found fixed in the spinal cord and brain of the inoculated animal, and "rabies virus" means both microorganism and tissue. The spinal cord of rabbits killed with an attenuated virus is removed and dried a varying length of time, and 1 cm. of the cord cut off on different days: this cord emulsified in salt solution is the material used for injections, and the early treatments are given with the cord which has been dried the longest. The injection is made subcutaneously. In the original Pasteur treatment the first inoculations were made with cord dried 11 days:

TABLE IV

TREATMENT FOR ADULTS

| DAY OF TREATMENT | CORD DRIED, DAYS | AMOUNT OF CORD CM. |
|---|---|---|
| First | 6 | 1 |
| Second | 5 | 1 |
| Third | 4 | 1 |
| Fourth | 3 | 0.5 |
| Fifth | 3 | 0.5 |
| Sixth | 2 | 0.5 |
| Seventh | 2 | 0.5 |
| Eighth | 1 | 0.5 |
| Ninth | 5 | 0.5 |
| Tenth | 4 | 0.5 |
| Eleventh | 4 | 0.5 |
| Twelfth | 3 | 0.5 |
| Thirteenth | 3 | 0.5 |
| Fourteenth | 2 | 0.5 |
| Fifteenth | 2 | 0.5 |
| Sixteenth | 4 | 0.5 |
| Seventeenth | 3 | 0.5 |
| Eighteenth | 2 | 0.5 |
| Nineteenth | 3 | 0.5 |
| Twentieth | 2 | 0.5 |
| Twenty-first | 1 | 0.5 |

the U. S. Public Health Service Hygienic Laboratory, however, recommends the omission of such long-dried cords as being inert and useless. Their scheme is shown in Table IV.

**Indications for Its Use.**—The bite of a rabid animal, with an actual break in the skin, is sufficient ground for a full series of inoculations. The killing of the animal and finding of Negri bodies in the brain furnishes the final evidence. This final evidence is, however, by no means always possible to obtain. In most instances the treatment will have to be undertaken on suspicion. The animal runs away, cannot be found, or is killed and the carcass destroyed by some unlettered policeman, so that the entire situation is in the air. The physician usually has to make the decision without clear-cut facts.

The treatment is not always without danger. In a very small proportion of cases a paralytic condition develops which may be due to the vaccine or to the virus (the infection) modified by the vaccine: about 25 per cent of the cases which are thus paralyzed die, the remainder recover.

Neither does the treatment always protect. In just what proportion of cases it does protect it is difficult to say on account of the unreliability of statistics as outlined above: we have no sure way of saying how many people who take the treatment have been infected with rabies. Of those who take it, however, we know that a few develop rabies.

Further all humans infected do not develop clinical rabies: the most reliable figures, collected by Doebert in Prussia from 1902-1907, put it that only about 15 per cent of humans, certainly bitten by rabid animals, and untreated, die from rabies.

### G. Vaccination Against Smallpox

The history of this, the oldest method of preventing disease by biologic specific prophylaxis, should be known to every physician. The practice of inoculation against smallpox was observed by Lady Mary Wortley Montague, in Turkey, who thus described it: "I am going to tell you a thing that I am sure will make you wish yourself here. The smallpox, so fatal and so general amongst us, is here rendered entirely harmless by the invention of ingrafting, which is the term they give it. There is a set of old women who make it their business to perform the operation every autumn, in the month of September, when the great heat is abated. People send to one another to know if any of their family has a mind to have the smallpox; they make parties for this purpose, and when they are met (commonly fifteen or sixteen together), the old woman comes with a nutshell full of the matter of the best sort of smallpox, and asks what veins you please to have opened. She immediately rips open that you offer to her with a large needle (which gives you no more pain than a common scratch), and puts into the vein as much venom as can lie upon the head of her needle, and after binds up the little wound with a hollow bit of shell; and in this manner opens four or five veins. The Grecians have commonly the superstition of opening one in the middle of the forehead, in each arm, and on the breast to mark the sign of the cross; but this has a very ill effect, all these wounds leaving little scars, and is not done by those that are not superstitious, who choose to have them in the legs, or that part of the arm that is concealed. The children or young patients play together all the rest of the day, and are in perfect health to the eighth. Then the fever begins to seize them, and they keep their beds two days, very seldom three. Every year thousands undergo this operation; and the French ambassador says pleasantly, that they take the smallpox here by way of diversion, as they take the waters in other countries. There is no example of anyone that has died in it; and you may believe I am very well satisfied of the safety of this experiment, since I intend to try it on my dear little son."

Jenner's account of his experimentation with cow-pock virus, as contained in "An Inquiry into the Causes and Effects of the Variola Vaccinae, a Disease discovered in some of the western countries of England, particularly Gloucestershire, and known by the name of the Cow-pox" (London, 1798), must be given in his own words:

"There is a disease to which the horse, from his state of domestication, is frequently subject. The farriers call it the grease. It is an inflammation and swelling in the heel, from which issues matter possessing properties of a very peculiar kind, which seems capable of generating a disease in the human body (after it has undergone the modification which I shall presently speak of), which bears so strong a resemblance to the smallpox that I think it highly probable it may be the source of the disease.

"In this country a great number of cows are kept, and the office of milking is performed indiscriminately by men and maid servants. One of the former having been appointed to apply dressings to the heels of a horse affected with grease, and not paying due attention to cleanliness, incautiously bears his part in milking the cows, with some particles of the infectious matter adhering to his fingers. When this is the case, it commonly happens that a disease is communicated to the cows, and from the cows to the dairy maids, which spreads through the farm until the most of the cattle and domestics feel its unpleasant consequences. This disease has obtained the name of the cowpox. It appears on the nipples of the cow in the form of irregular pustules. At their first appearance they are commonly of a palish blue, or rather of a color somewhat approaching to livid, and are surrounded by an erysipelatous inflammation. These pustules, unless a timely remedy be applied, frequently degenerate into phagedenic ulcers, which prove extremely troublesome. The animals become indisposed, and the secretion of milk is much lessened. Inflamed spots now begin to appear on different parts of the hands of the domestics employed in milking, and sometimes on the wrists, which quickly run on to suppuration, first assuming the appearance of the small vesications produced by a burn. Most commonly they appear about the joints of the fingers and at their extremities; but whatever parts are affected, if the situation will admit, these superficial suppurations put on a circular form, with their edges more elevated than their centers, and of a color distinctly approaching to blue. Absorption takes place, and tumors appear in each axilla. The system becomes affected—the pulse is quickened; and shiverings, succeeded by heat, with general lassitude and pains about the loins and limbs, with vomiting, come on. The head is painful, and the patient is now and then even affected with delirium. These symptoms, varying in their degrees of violence, generally continue from one day to three or four, leaving ulcerated sores about the hands, which, from the sensibility of the parts, are very troublesome, and commonly heal slowly, frequently becoming phagedenic, like those from whence they sprung. The lips, nostrils, eyelids, and other parts of the body are sometimes affected with sores; but

these evidently arise from their being heedlessly rubbed or scratched with the patient's infected fingers. No eruptions on the skin have followed the decline of the feverish symptoms in any instance that has come to my inspection, one only excepted, and in this case a very few appeared on the arms: they were very minute, of a vivid red color, and soon died away without advancing to maturation; so that I cannot determine whether they had any connection with the preceding symptoms.

"Thus the disease makes its progress from the horse to the nipple of the cow, and from the cow to the human subject.

"Morbid matter of various kinds, when absorbed into the system may produce effects in some degree similar; but what renders the cowpox virus so extremely singular is that the person who has been thus affected is forever after secure from the infection of the smallpox; neither exposure to the variolous effluvia, nor the insertion of the matter into the skin, producing this distemper. * * *

"Case XVII.—The more accurately to observe the progress of the infection I selected a healthy boy, about eight years old, for the purpose of inoculating for the cowpox. The matter was taken from a sore on the hand of a dairy maid, who was infected by her master's cows, and it was inserted, on the fourteenth day of May, 1796, into the arm of the boy by means of two superficial incisions, barely penetrating the cutis, each about an inch long.

"On the seventh he complained of uneasiness in the axilla and on the ninth he became a little chilly, lost his appetite, and had a slight headache. During the whole of this day he was perceptibly indisposed, and spent the night with some degree of restlessness, but on the day following he was perfectly well.

"The appearance of the incisions in their progress to a state of maturation were much the same as when produced in a similar manner by variolous matter. The difference which I perceived was in the state of the limpid fluid arising from the action of the virus, which assumed rather a darker hue, and in that of the efflorescence spreading round the incisions, which had more of an erysipelatous look than we commonly perceive when variolous matter has been made use of in the same manner; but the whole died away (leaving on the inoculated parts scabs and subsequent eschars) without giving my patient or me the least trouble.

"In order to ascertain whether the boy, after feeling so slight an affection of the system from the cowpox virus, was secure from the contagion of the smallpox, he was inoculated on the 1st of July following with variolous matter, immediately taken from the pustule. Several slight punctures and incisions were made on both his arms, and the matter was carefully inserted, but no disease followed. The same appear-

ances were observable on the arms as we commonly see when a patient has had variolous matter applied, after having either the cowpox or smallpox. Several months afterwards he was again inoculated with variolous matter, but no sensible effect was produced on the constitution."

**Technic of Vaccination.**—*Site.*—The outer surface of the arm, just below the insertion of the deltoid. In girls belonging to the nobility and gentry, on the inner surface of the leg below the knee.

*Sterilization of Skin.*—Any method—(1) Soap and water; (2) soap, water and alcohol; (3) alcohol alone; (4) ether alone; (5) soap, water, alcohol and ether—will do. None has any advantage. None will kill the virus. I recently proved this to my own satisfaction at the time of a wholesale vaccination rush, at the outpatient department of the University of Kansas Medical School. I took ten youngsters and sterilized the arm with soap and water, ten with soap and water and alcohol, etc., and then followed them all very closely.

There was no difference. All that is needed for a successful take is good virus and a susceptible person.

*Method of Inoculation.*—The skin is broken, with scratches of a needle or knife or Von Pirquet scarifier and the virus placed on and rubbed into the abrasion. When dry it is covered with a dressing.

*Period of Incubation.*—Usually four days. A papule appears surrounded by a zone of inflammation. The vesicle appears about the sixth day umbilicated. It attains its maximum size about the eighth day. By the fourteenth day it is covered with a scab and the inflammation has subsided.

### H. Tuberculin

A number of different kinds of tuberculin have been introduced by various experimenters or clinicians. Each has a designation by which it often appears in the literature, as OT. The most frequently used today with their designations are:

**1. Old Tuberculin—OT.**—The original product introduced by Koch in 1891. It is made by growing human bacilli on bouillon enriched with 5 per cent glycerin: after growing for six or eight weeks, it is sterilized and concentrated by a current of steam, and filtered through a Chamberland filter. The filtrate, a brown clear fluid of characteristic odor, which contains 50 per cent glycerin (the glycerin not being evaporated by the steam) is the product used.

**2. New Tuberculin—or Tuberculin Residue—T.R.**—Was introduced by Koch in 1897. Cultures of tubercle bacilli are ground in an agate mor-

tar, water added, the mixture centrifugalized, the fluid saved, poured off, and the process repeated until there is no residue. The fluids from all the centrifugalizations, except the first, are precipitated with glycerin and constitute the T.R. It contains practically dried dead particles of tubercle bacilli.

**3. Bacillen Emulsion—B.E.**—Introduced by Koch in 1901. Its name well describes it. Cultures of tubercle bacilli on bouillon are grown, the bacilli filtered off, and ground but not washed. One part of the pulverized material is emulsified in 100 parts of distilled water, and an equal volume of glycerin added.

**4. Bouillon Filtrate—B.F.**—Introduced by Denys in 1905. A culture of tubercle bacilli is made on bouillon. At the end of six or eight weeks, the mixture, without being heated or concentrated in any way, is passed through a bacteria-proof porcelain filter. The residue is rejected, the filtrate is used without further modification.

**5. Beraneck's Tuberculin.**—Introduced by Beraneck in 1903. The bacilli are cultivated on a nonpeptonized 5 per cent glycerin bouillon medium, not neutralized. The culture is filtered, the filtrate saved, and the residue shaken for a long time at 60 to 70° C. with 1 per cent orthophosphoric acid. The tuberculin consists of equal parts of the unheated filtrate and the orthophosphoric acid extract of the bacilli.

A number of others have been introduced—such as Von Ruch's watery extract, Spengler's tuberculins (ATO, PTO, TBE, etc., made in most instances from bovine tubercle bacilli), Jochmann's Krehl and Mathers', Tebean, etc.

An analysis of the method of preparation of the five tuberculins which we have given in detail, will show that there are two elements apparently recognized by the originators. One is the dead bacilli themselves, the other the products of the growth of tubercle bacilli on culture media. Thus the old tuberculin is very largely made up of the products of the growth of the bacilli on bouillon, abstracted partly with glycerin; the dead bacilli themselves, except by accident or in very small amounts, do not enter into its composition. The bacillen emulsion on the other hand is practically nothing but the dead bacilli. Beraneck's tuberculin includes both elements.

All of the above five mentioned tuberculins will cause a reaction in a tuberculous individual and each has been used successfully by some competent clinician. Hamman and Wolman wrote to a number of workers and found that for each variety of tuberculosis, one tuberculin was regarded by some physician as the most suitable. For most, however,

the list stays close to one of the above five. Most workers, I should say, use the old tuberculin. A good number, however, use B.F., B.E. or Beraneck's tuberculin.

**Theory of Action of Tuberculin.**—The fundamental immunologic experiment with tuberculosis is that performed by Koch. He found that if an emulsion of living tubercle bacilli is inoculated into the skin of a healthy guinea pig, the wound closes, and in the first few days seems to be healed. In from ten to fourteen days a hard nodule appears, which soon forms an ulceration, which ulceration remains until the death of the animal from the general tuberculosis infection; there is also an enlargement of the lymphatic glands of the ulcerated area. Koch pointed out the contrast between this condition and the subcutaneous inoculation of living tubercle bacilli in a guinea pig which already has a generalized tuberculosis from an inoculation four to six weeks previously. The wound at first closes as in the uninfected pig. The animal, within two or three days, becomes acutely sick: then the wound becomes hard and dark to a radius of 1 cm. but it does not form a definite nodule: soon the dark skin becomes necrotic and is sloughed off, leaving a flat ulceration which soon heals: the neighboring lymph glands are not involved, and the guinea pig usually lives longer than a tuberculous guinea pig in which no secondary inoculation has taken place.

What is the cause of this difference? What is the nature of this reaction? Does tuberculin act like a vaccine? If so how does a vaccine act? The matter has been argued at no inconsiderable length. I find that a review of the discussion occupies over thirty pages in Hamman and Wolman's book on tuberculin. The curious are referred to it. The concensus of opinion seems to be that it is in the nature of an anaphylactic phenomenon. At least in the light or diagnostic form the reaction is this. Tuberculin injected into healthy animals causes no symptoms, nor does it ever cause death. If then it is curative, how does it act?

There is also some controversy as to whether it *does* act curatively. Such a good clinician as Fishberg says quite definitely that it is of no value. Others think that in properly selected cases, carefully given it is of some value, combined with other forms of tuberculosis treatment. It can be said that it should not be considered in the light of an antitoxin, that is, it does not kill the tubercle bacilli directly, neither is it bactericidal: it acts, if it acts at all, by stimulating the natural resources of the body; that is, it acts somewhat as we conceive a vaccine to act. It produces probably a congestion or inflammatory reaction at the point of infection: this can be seen in tuberculous lesions which are on an exposed part: Pottenger, for instance, has seen tuberculous ulcers on the tongue heal under tuberculin—the small dose causes a slight red-

dening, the large dose a considerable inflammatory reaction around the ulcer.

**Method of Administration, Dosage, and Results.**—When Koch first announced tuberculin in 1891, it was greeted with unbounded enthusiasm: the discoverer of the tubercle bacilli, who had the complete confidence of the scientific world, had announced a cure for tuberculosis. In using it, Koch, on the basis of his classical experiment, did not believe it would be of any benefit unless given in sufficient dosage to cause a reaction, with focal necrosis. It was given then in doses of 1 c.c. and thereabouts. The result was that the processes of many patients were lighted up, and deaths resulted. There was as great an outcry as there had been enthusiasm previously, and the method fell into disuse. When it was revived, much smaller doses were given, the patients were carefully selected, and intervals between doses were established.

**Choice of Patients.**—In general patients who under rest and extra food are gaining in weight, losing the fever and improving in appearance and feeling, are the favorable cases for tuberculin. Mild early cases are thus the best. But fever itself, tubercle bacilli in the sputum, or moderately advanced or advanced cases are not necessarily a contra-indication to tuberculin. Only in these cases the administration must be undertaken with care and stopped if it seems that the tuberculin is not effecting improvement.

**Dosage.**—It should be given just as a vaccine is given, that is, it must be given in small doses, the interval between the doses must allow for the reaction to run its course, before the next dose is given, and the dosage must be gradually increased.

The initial dose varies somewhat with the kind of tuberculin used and the patient's condition. The following table indicates an average dosage for the different tuberculins. The dosage is given in cubic centimeters; in many places the dosage is given in milligrams, but as tuberculins are really liquids and the amount of solid substance is not accurately standardized, it is better to measure the dosage in liquid measure. In the table 0.000,000,1 c.c. is 0.000,1 c.mm., or $\frac{1}{10.000}$ of a mg.: 0.000,001 c.c. is 0.001 c.mm., or $\frac{1}{1000}$ mg.

TABLE V

TABLE OF AVERAGE INITIAL AND MAXIMUM DOSAGE FOR 5 TUBERCULINS

| TUBERCULIN | INITIAL DOSE | MAXIMAL DOSE |
|---|---|---|
| OT | 0.000,000,1 c.c. to 0.000,001 c.c. | 1.0 c.c. |
| TR | 0.000,001 c.c. to 0.000,1 c.c. | 2.0 c.c. |
| BE | 0.000,001 c.c. to 0.000,1 c.c. | 2.0 c.c. |
| BF | 0.000,000,01 c.c. to 0.000,000,1 c.c. | 1.0 c.c. |
| Beraneck's | of A / 32. 0.05 c.c. | H 1.0 c.c. |

**Increase of Dosage, and Interval between Dosage.**—It is desirable to avoid severe reactions. Some slight reaction, as evidenced by the above mentioned inflammation reaction seen in exposed ulcers, is desirable but it is not desired that a reaction with fever, prostration, and signs of intense local activity be accomplished. These, in fact, do harm and the whole aim of the tuberculin administration is to increase the dose without producing such a reaction. To do this strict attention to details, and constant observation of the patient are required. No mathematical scheme for increasing dosage can be made and adhered to. In some cases the dosage can be increased very rapidly, in others it must be very slow. The phases of a reaction after an injection of tuberculin are three: there is a primary depression (of the opsonic index or its equivalent), a secondary rise, and third a fall to the original level. It should be the aim of the treatment to add the next dose of tuberculin at the middle of the secondary rise—because by this means a continuous increase in tolerance and improvement is obtained. In the smaller doses, this secondary rise occurs about the third or fourth day, and lasts two or three days: in the larger doses it occurs about the fourth to sixth day and may last two weeks. Thus as the dose increases in size the interval between doses should be lengthened: in the first few doses the interval may be two or three days, and later increase to five, six or seven days.

Sahli has put out some tables to show the increase in the size of the dose in different dilutions. The figures indicate the amount of the solution to give, as measured in a tuberculin syringe.

| 2 | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 15 | 20 |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 32 | 22 | 18 | 16 | 15 | 13 | 13 | 12 | 12 | 11 |
| 100 | 46 | 32 | 25 | 22 | 18 | 16 | 15 | 14 | 12.5 |
| | 100 | 56 | 40 | 32 | 24 | 20 | 18 | 16 | 14 |
| | | 100 | 63 | 46 | 32 | 25 | 22 | 18.5 | 16 |
| | | | 100 | 68 | 42 | 32 | 26.5 | 21.5 | 18 |
| | | | | 100 | 56 | 40 | 32 | 25 | 20 |
| | | | | | 75 | 50 | 38 | 29 | 22 |
| | | | | | 100 | 63 | 46 | 34 | 25 |
| | | | | | | 79 | 56 | 40 | 28 |
| | | | | | | 100 | 68 | 46.5 | 31.5 |
| | | | | | | | 83 | 54 | 35 |
| | | | | | | | 100 | 63 | 40 |
| | | | | | | | | 74 | 50 |
| | | | | | | | | 86 | 56 |
| | | | | | | | | 100 | 63 |
| | | | | | | | | | 71 |
| | | | | | | | | | 79 |
| | | | | | | | | | 89 |
| | | | | | | | | | 100 |

**Practical Considerations:** A tuberculin syringe is nearly a necessity in the administration of tuberculin. This is a 1 c.c. syringe, graduated

into hundredths, with a dark colored plunger, so that very exact amounts of fluid can be recognized and injected.

The physician should dilute his tuberculin himself. In high dilutions as sold by drug firms it does not keep. Table VI will give the proper dilutions.

TABLE VI

SHOWING METHOD OF DILUTING OT

| DILUTE: STERILE NORMAL SALT SOLUTION AND .4 PHENOL. | | 1. C.C. CONTAINS IN MILLIGRAMS | IN CUBIC MILLIMETERS |
|---|---|---|---|
| 1. c.c. Original solution | .................. | 1000. | 1000. |
| .1 c.c. Original solution | – .9 c.c. diluent – I | 100. | 100. |
| .1 c.c. Solution I | – .9 c.c. " – II | 10. | 10. |
| .1 c.c. II | – .9 c.c. " – III | 1. | 1. |
| .1 c.c. III | – .9 c.c. " – IV | .1 | .1 |
| .1 c.c. IV | – .9 c.c. " – V | .01 | .01 |
| .1 c.c. V | – .9 c.c. " – VI | .001 | .001 |

In other words solution No. VI has $\frac{1}{1000}$ mg. in 1 c.c. Therefore putting 1 c.c. of solution No. VI in a tuberculin syringe and consulting Sahli's table, the extreme left hand column shows the first dose to be 0.1 c.c. or $\frac{1}{10,000}$ mg., or 0.000,000,1 c.c. as in the advised dose given in Table I above. The second dose of 0.32 c.c. of the same solution is easily measured in the tuberculin syringe, and equals, approximately $\frac{1}{3000}$ mg., etc.

**Results with Tuberculin.**—A wide divergence of opinion is expressed upon this subject by equally competent men. There are those who say that since tuberculin is given only to patients who are getting better, or who are slightly advanced, since it is given in conjunction with all other modes of treatment, and since it is given in such small doses that no measurable result occurs—the circumstances under which it is administered preclude any possibility of judging whether it is of value or not.

The advocates of its use, on the contrary, point out four arguments:

First—it does have some action. If given in sufficient dosage it does something to a tuberculous individual that it does not do to a normal individual.

Second—its action as observed upon tuberculosis in exposed parts is favorable. The observations of Pottenger quoted above are in point here.

Third—careful comparative statistics upon patients not receiving tuberculin and those receiving tuberculin indicate that it is of value in promoting a more rapid cure. Hamman and Wolman, for instance, take an objective sign; the presence of tubercle bacilli in the sputum. This

is something that can be measured, and has the additional advantage that we know certainly the patient has tuberculosis. They marshal a large number of such cases, treated with and without tuberculin and show that with tuberculin the bacilli disappear from the sputum not quite twice as often as in the cases treated without tuberculin. (Forty-seven per cent as against 27 per cent—Turban.)

Fourth—carefully compiled statistics show that with tuberculin cases remain healed longer than without.

On the basis of these considerations, it is, I believe, fair to consider that tuberculin, in properly selected cases, given with due attention to details of treatment, is a valuable therapeutic agent.

### I. Pertussis Vaccine

The specific cause of pertussis has not been determined to the satisfaction of all bacteriologists, although there are good reasons for believing that the bacillus isolated by Bordet and Gengou is such. Vaccines prepared from this bacillus have been used for both prophylactic and curative purposes.

**For Prophylactic Use.**—Three injections, one weekly. For children—first dose 500 million bacilli, second dose 1000 million bacilli. For adults—1000, 2000, and 3000 million bacilli.

**For Treatment.**—A first subcutaneous injection of 500 million bacilli; 48 hours later a third dose of 2000 million. Five days later, if paroxysms persist, 4000 million are given followed in three days with a dose of 8000 million, and three days later by 10,000 million.

The most careful observers are of the opinion that the vaccine is valueless, either for prevention or cure.

### J. Vaccines for "Colds," Bronchitis, Acute Rhinitis, Pneumonia and Influenza

Both for the prevention and treatment of these diseases, vaccines have been thoroughly tried in every form now known and they have been repeatedly proved to be utterly worthless, and probably harmful.

## III. NONSPECIFIC PROTEIN THERAPY

The use of nonspecific proteins, in place of specific vaccines, followed soon upon the development of experience with the vaccines. Schmidt in 1910, observed that after a course of any kind of vaccine, the resistance of the body to all infections was increased. Rumpf had found, and been roundly abused for it that the use of Bacillus pyocyaneus vaccine

was just as good as typhoid vaccine in the treatment of a series of cases of typhoid fever—just as good, that is, as his colleague, Frankel's results in typhoid fever with typhoid vaccine. It was found that, while gonococcus vaccine *subcutaneously* was of little value in acute or chronic urethritis, the use of gonococcic vaccine *intravenously* was of value in the treatment of the complications of gonococcic infection—epididymitis and arthritis. And then it was found that typhoid vaccine intravenously was equally good in these conditions.

Thus from a large number of observations it has come to be believed that the use of nonspecific proteins is quite as valuable as the use of specific vaccines. In certain conditions to be detailed below, they act so well that it must be said that they are better than specific vaccines.

No very satisfactory explanation of this series of facts has been given. It may be said that opsonins are nonspecific in character and that the stimulation of the formation of any opsonin is all that is required; but immunologists deny this and state that opsonins are specific. The monumental work of Vaughn on the splitting of bacterial proteins may furnish some light. On this basis we may say that:

1. The bodily reaction, i.e., the physiologic pathology of all infectious disease is due to poisonous proteins.

2. In the body, as defences, we have some nonspecific proteolytic ferments.

3. Intravenous injection of foreign protein stimulates the production of more of these ferments, or stimulates those present to greater activity.

The nonspecific protein usually used is typhoid vaccine—killed typhoid bacilli. Milk from which the fat has been removed and which has been sterilized is marketed in ampoules (aolan). Peptone is also used.

The protein should be given intravenously. From an experience of some variety with consultants and interns I do not believe this fact is sufficiently understood. Intramuscular injection, while usually less effective, has been employed for milk injections in pelvic infections.

There is always a reaction. It usually begins within one or two hours, with a violent chill, and rise in temperature and pulse rate. There has been observed a fall in blood pressure, both of the systolic and diastolic phase, a reduced coagulability of the blood, and a leucocytosis from 20,000 to 50,000. In most cases it is of no moment, but Miller reports one fatal reaction in an alcoholic who developed delirium tremens.

Contraindications are quiescent tuberculosis, cardiac decompensation, diabetes, and pregnancy.

The conditions in which it has been used most successfully are:

1. **Arthritis.**—Of various kinds, chronic, subacute, and even acute; of varied etiology, particularly gonococcic. In 93 cases of acute arthritis,

Miller reported 80 cases greatly relieved, in from one to four injections given daily. The initial dose is usually 40 million typhoid bacilli, intravenously, increasing to 150 million. Many of the acute cases had failed to improve on salicylates. Of 18 patients with subacute arthritis, 14 were benefited. Recurrences were common, but with the clearing up of foci of infection these were reduced. Of 28 patients with chronic arthritis, none were entirely cured but several were benefited.

2. **Typhoid Fever.**—Ichikawa, Kraus and Mozza and other observers, giving 200 million typhoid bacilli intravenously were able to terminate 20 per cent of their cases of typhoid fever after four or five days by crisis. Ichikawa afterwards showed that the reaction was not specific as he could use colon vaccine and obtain the same results. The treatment has not come into general use, although no bad results were reported.

3. **Gonococcic Infections.**—All infections by the gonococcus react to nonspecific protein therapy. Gonococcic arthritis responds better to intravenous typhoid bacilli than to specific gonococci vaccines. In the pelvic infections of women sterile milk protein injections (aolan) intramuscularly in the buttocks, 5 to 10 c.c. every three to five days, clear up the condition promptly and save the patient from surgical operations, which, to be effective, usually have to be completely unsexing. In epididymitis and bartholinitis these injections are also effective.

4. **Iritis**—so-called rheumatic iritis.

5. **Skin Diseases.**—Psoriasis, Eczema, Pyogenic Infections of the Skin, etc.

6. **Migraine and epilepsy** have been treated with peptone injections.

7. **Peripheral vascular diseases,** such as Buerger's disease, presenile gangrene, thrombo-angiitis, obliterans and erythromelalgia. In these, nonspecific protein therapy by the use of intravenous typhoid bacilli is the first method that should be employed. The dose of typhoid bacilli is 125 million and up used intravenously once a week.

8. **Peptic Ulcer.**—Martin has used parenteral milk injections with great success in ambulatory ulcer cases. Most of the patients had no other treatment—dietary or medicinal; 83.2 per cent were improved.

## IV. CONVALESCENT SERUM

In a large group of (evidently) infectious diseases we have no knowledge of their specific bacterial cause. Therapy by specific vaccines or by antisera is evidently impossible. In many of these therefore the use of the serum of patients who have recently recovered from the disease has been used. The theoretical reasons for this are obvious; either to

supply actual antibodies, or to stimulate the formation of antibodies by the patient's organism.

The best results so far have been obtained in scarlet fever. Some good results have been obtained in epidemic poliomyelitis. More debatable are those of influenza. And in measles, smallpox and chickenpox no definite clinical results have yet been recorded.

**In scarlet fever,** Weaver furnishes the following technic:

**Collection and Preparation of the Serum.**—The patient, from whom blood is to be obtained, is examined carefully to detect any evidence of tuberculosis; a Wassermann reaction must be negative; and he must have passed through a typical scarlet fever, without septic complications.

**The blood is drawn** at the fourth to the seventh week. The fifth is probably the best time. The serum from those who have had a mild attack has been found to be as effective as from those who have had a severe attack. But there is considerable variation in efficiency of the serum from different individuals, and Weaver advises mixing the serum from several individuals. About 300 c.c. of blood is usually obtained from adults, proportionately less from children. After the serum is separated it is inactivated at 56° C. for half an hour and 0.3 per cent of tricresol added. Cultures are made, and if sterile, it is kept, after mixing, in 30 c.c. bottles, tightly corked and kept in a refrigerator. The serum should be used within eight weeks, the sooner the better.

**Dosage and Method of Administration.**—Weaver has used the serum, intramuscularly, in doses of from 60 to 90 c.c. It is usually given in the thigh. When satisfactory response has not been made, a second dose may be given in twenty-four hours.

**Results.**—Every competent clinician who has tried it has testified to his belief in its efficiency. The temperature begins to fall in two or three hours, and the general condition of the patient is improved out of all proportion to the fall in temperature.

**In poliomyelitis,** the technic of the collection of serum is the same as in scarlet fever. It should be administered as early in the attack as possible: serum given after the febrile period is probably useless. The serum is given intraspinally and intravenously; the same amount of serum, less 10 c.c., as the amount of spinal fluid withdrawn, intraspinally, and from 40 c.c. to 100 c.c. intravenously. The administration may be repeated, by both routes, if considered advisable in twenty-four hours. The report of Amoss and Chesney, which is very favorable, should be read for a consideration of the results.

**Influenza.**—Convalescent serum was used sporadically during the lat-

ter parts of the 1918 and 1919-1920 epidemics. Various observers are not quite in unison as to the efficacy.

In **measles** no good results have been as yet obtained, though observations are still being made.

In **smallpox,** the only epidemic in which convalescent serum has been used, so far as I know, was in the extremely severe epidemic of 1921 in Kansas City. I had an opportunity of seeing these cases, which were of an extremely severe hemorrhagic or confluent type with a high mortality. The convalescent serum did not seem to act favorably on the very severe cases in which it was used.

## V. INOCULATION OF LIVING ORGANISMS

### The Malaria Treatment of Neurosyphilis, Particularly Paresis

Remarkable results have attended the treatment of general paresis by the inoculation into the patient of malaria organisms. After a series of chills and corresponding high temperature, the malaria is killed off by quinine, and in from 50 per cent to 60 per cent of cases the paretic begins to get better symptomatically and later the Wassermann and other serologic reactions in the blood and spinal fluid show reversal (i.e., tend to become normal).

The treatment has been employed very widely in American psychiatric practice for several years now, the earliest reports being made about 1924. The origin of the method has been told me in a story probably apocryphal but which contains so much theoretical rationale as to be worth repeating. It is said that some years ago in a Danish insane asylum an epidemic of erysipelas broke out which particularly affected the ward where the paretics were segregated. After it was over the medical director was astonished to find that a large number of the paretics were undergoing symptomatic remissions of the paresis. With the idea that the high temperatures endured during the period of the erysipelas produced some favorable influence on the paresis (killed off the spirochetes we may suggest now), he began attempting to inoculate other paretic patients with erysipelas, but he found the mortality to be prohibitive. Whether this anonymous Danish psychiatrist of the story which was told to me is identical with Wagner von Jauregg of Vienna, who in 1887 reported in the literature attempts to treat paretics with injections of tuberculin, typhus vaccine and other means to induce fever, it is impossible to say. After trying numerous substances, the psychiatrist of my legend is said to have heard that in a certain district in Central America the Indians who inhabited the lowlands where there was a great deal of malaria were almost entirely free from syphilis, whereas the nearby and closely related tribes in the mountains where there was little

malaria had an average percentage of syphilis. In this connection Wile's report of a woman with multiple chancres is interesting: the chancres were swarming with spirochetes and the patient was inoculated with malaria to see whether it would have any effect on spirochetes outside the spinal system; within a short time all the spirochetes disappeared from the chancres and they involuted much more rapidly than they otherwise would have done. The authentic statement of Delgado that from ancient antiquity Peruvian Indians suffering from uta, which is a protozoan parasitic disease of the skin and mucous membranes, a form of leishmaniasis, were accustomed to journey to malarial regions, as it was known that after a certain number of chills the uta would be healed, is in the same category of observations.

The influence of intercurrent infection on paresis is the subject of many clinical anecdotes. I know of one case in a man who several years ago exhibited undoubted mental symptoms of paresis: his serologic reactions were also positive. Following a series of severe intraspinal treatments he developed a paralysis of the bladder and a severe kidney infection. He had daily temperatures of 105 for some time. He finally conquered the infection and, to the astonishment of his medical attendants, as his kidney infection improved his mind became completely clear. I see him quite frequently responsibly attending to his various vocations and avocations.

How these infections act is not known. One theory is that the spirochetes cannot live in a temperature over 104° or 105° F. An alternate idea is that some toxins are formed from the new infection which are unfavorable to the growth of the spirochetes. Freeman, in an extremely valuable paper, has recorded his observations on the histologic change in the cerebral cortex of some patients with paresis who had a certain number of chills following malarial inoculation but who died at varying intervals afterwards. He showed that the first change was an extensive perivascular infiltration and organization of the inflammatory exudate in the meninges and about the blood vessels. During the following months the exudates are resorbed and the glia and vascular tissues regress to a great degree. Finally the cortical architecture is reconstructed by resumed cellular polarity, and restored lamination and perhaps by thickening of the cortex. The ganglion cells of the cortex are more or less reduced in number. Freeman is very optimistic about the treatment from his histologic studies and feels that the term, recovery, is justified rather than the more conservative term, remission, which is usually used by neurologists.

The technic of the method is not difficult. The most puzzling part of the procedure for a physician in the temperate zone is to obtain a patient with tertian malaria. However, most hospitals for the insane have

now one or more patients with paresis who are infected with malaria and from whom blood can be obtained. There seems no danger to be apprehended from using blood from such patients.

A quantity of blood ranging from 1 to 7 c.c. is removed from an arm vein of a patient with tertian malaria, using an ordinary intravenous needle and syringe.

The time when the blood is removed from the malaria patient is preferably at the height of, or shortly after, a chill.

The quicker the blood is injected into the recipient the better, although Dr. O'Leary reports that blood was transported half across the continent and injected eighty hours after removal with a successful inoculation resulting. If any length of time is to elapse between withdrawal and reinjection of the blood, it should be citrated and kept at body temperature if possible. The paretic patient who is to receive the blood from the malaria patient may have it given subcutaneously, intravenously or intramuscularly.

The incubation period of the malaria is variable from two to thirty days.

It is desirable to have as high a temperature during the malarial paroxysms as possible, but enormous variations appear to occur in different individuals with the same strain of malaria inoculated.

The treatment should be stopped with quinine after a certain number of chills. How many must be left to the clinical judgment of the physician. When the patient is extremely exhausted and does not seem to be tolerating the malaria well, it must, of course, be stopped. Six chills are considered the minimum desired. From there on to twenty is possible—the more the better, other things being equal.

To stop the malaria give quinine bisulphate by mouth 10 grains three times a day. See the account of quinine in Chapter II, Part I. The artificially inoculated malaria seems generally easier to terminate than the natural kind.

Arsphenamine or neoarsphenamine should not be given during the period of malaria infection—as these drugs are antagonistic to malaria.

**Results.**—The mortality is about 5 per cent. This, of course, is a difficult figure to decide upon as the disease itself has a mortality and it is not easy always when death occurs to decide which factor was responsible.

About 50 per cent of all patients with paresis after malaria inoculation go into remission and remain so. They have remained so at least for the three or four years the method has been under trial. Vigorous arsenic, mercury and bismuth treatments are not contraindicated after remission has taken place. The malaria treatment is by all odds the best one we have at present for paresis.

## References

Allen and Smithwick: Use of Foreign Protein in the Treatment of Peripheral Vascular Disease: Jour. Am. Med. Assn., Oct. 20, 1928, xci, No. 16.

Amoss and Chesney: Jour. Exper. Med., April, 1917, xxv, 581.

Avery, Chickering, Cole and Dochez: Acute Lobar Pneumonia and Its Serum Treatment—Monograph 7, Rockefeller Institute, November, 1918.

Blake, Trask, and Lynch: Treatment of Scarlet Fever with Scarlatinal Antistreptococcic Serum, Jour. Am. Med. Assn., March 19, 1924, lxxxii, No. 9.

Bunker and Kirby: Treatment of General Paresis by Inoculation with Malaria, Jour. Am. Med. Assn., Feb. 21, 1925, lxxxiv, No. 8.

Dick and Dick: The Etiology of Scarlet Fever, Jour. Am. Med Assn., Vol. 82. No. 4. Jan 26, 1924, lxxxii, No. 4.

Dochez and Sherman: Streptococcus Hemolyticus in Scarlet Fever, Jour. Am. Med. Assn., Feb. 16, 1924, lxxxii, No. 7.

Flexner: Mode of Infection, Means of Prevention, and Specific Treatment of Epi demic Meningitis, Jour. Am. Med. Assn., September, 1917, lxix, No. 8.

Freeman: Malaria Treatment of General Paralysis. Histopathologic Observations in Fifteen Cases, Jour. Am. Med. Assn., April 2, 1927, lxxxviii, No. 14.

Gellhorn: Milk Injections for Pelvic Infections in Women, New Orleans Med. and Surg. Jour., March, 1926, lxxviii, No. 6.

Goldsmith and Rockwood: The Treatment of Neurosyphilis and Paresis with Malaria. Am. Jour. Syph., April, 1927, xi, No. 2.

Hamman and Wolman: Tuberculin in Diagnosis and Treatment, D. Appleton Co., 1914, Complete bibliography.

Hektoen: Old and New Knowledge of Immunity, Jour. Am. Med. Assn., December, 1921, lxxvii, No. 25.

Ichikawa: Abortive Treatment of Typhoid and Paratyphoid Fevers, Sei-i-kwai Med. Jour., 1913, xxxiii, 73.

Jauregg, Wagner von: Ueber die Einwirkung fieberhafter Erkrankungen auf Psychosen Jahrb. f. Psychiat., 1887, vii, 94.

Karsner and Ecker: The Principles of Immunology, Philadelphia, 1921, J. B. Lippincott Company.

Kraus and Mazza: München. med. Wchnschr., 1914, lxi, 1967.

Miller, J. L.: The Nonspecific Character of Vaccine Therapy, Jour. Am. Med. Assn., September 8, 1917, lxix, No. 10.

O'Leary: Treatment of Neurosyphilis by Malaria, Jour. Am. Med. Assn., July, 9, 1927, lxxxix, No. 2.

Park: Scarlet Fever, Jour. Am. Med. Assn., October 17, 1925, lxxxv, No. 16.

Park: Active Immunization of Diptheria, Jour. Am. Med. Assn., January, 1921, lxxvi, No. 2.

Park, Zingher and Serota: Active Immunization in Diphtheria and Treatment by Toxin-Antitoxin, Jour. Am. Med. Assn., September 5, 1914, lxiii, 859.

Park and Zingher: The Schick Reaction, Arch. Pediatrics, July, 1914, xxi, 481.

Robertson: The Prophylactic Use of Tetanus Antitoxin, Am. Jour. Med. Sc., May, 1916, cli, No. 5.

Symmers: Antitoxin Treatment of Erysipelas, Jour. Am. Med. Assn., Aug. 25, 1928, xci, No. 8.

Weaver: Treatment of Scarlet Fever with Immune Human Serum, Jour. Am. Med. Assn., October 29, 1921, lxxvii, No. 18.

Zingher: The Dick Test and Immunity Results. Jour. Am. Med. Assn., August 9, 1924, lxxxiii, No. 6.

## CHAPTER IV

## EXTRACTS OF THE DUCTLESS GLANDS

In 1873, Gull, then the foremost consultant in London, described "a cretinoid state in women," or myxedema. In 1890 Horsley suggested grafting thyroid gland for myxedema and allied conditions, and in 1891 George Murray, a practitioner of Manchester, used thyroid extract hypodermically with success in a case of myxedema. The record of this first case will be given in detail below. Here we use it to point out the origin of the practice of giving extracts of the ductless glands for physiologic deficiencies of these organs. It will be the purpose of this chapter to point out briefly the definite results which have been found to follow their administration and to leave strictly alone the great body of speculation.

The organs of the body certainly known to be concerned in internal secretion are the thyroid gland; the pituitary gland, which has three distinct lobes—the anterior and posterior and pars intermedia; the adrenal gland which has two parts, the medulla and the cortex; the pineal gland; the parathyroids; the ovaries and testes; and the islets of Langerhans in the pancreas. Organs which have other functions, some well defined, some less so, but about which it has been supposed that they also pour a secretion, theoretically hormone-like, into the blood stream, are the mammary glands, the spleen, the prostate, the uterine mucosa, the placenta and the thymus.

The chief glands, and those usually affected by disease, are the thyroid, the pituitary and the gonads (ovaries and testes). All the ductless glands are interdependent and the secretion of one activates or exerts a hormone-action on the other glands. The most independent of all (that is, the one deficiency or hypersecretion of which is most likely to produce symptoms which cannot be ascribed to any of the others) is the thyroid; but even the thyroid in disease may produce symptoms—high sugar tolerance, tachycardia, menstrual disturbances—which seem to point to interdependent action on the part of other glands, respectively in the above instances, the islets of Langerhans, the adrenals, and the ovaries.

The whole chain of these glands exercises supervision over three functions of the animal body—growth, nutrition, and sex. The pituitary, gonads, thyroid (only as cretinism) and pineal particularly affect

growth. The thyroid, pituitary, adrenal, pancreas and parathyroid particularly affect nutrition. The gonads, pituitary, adrenal, pineal, and thyroid particularly affect sexual growth and function. But these distinctions are, by no means, hard and fast. In any case any dysfunction of a gland may result in dysfunction or an attempt at compensation in any other gland.

Presiding as they do over the conditions of growth and sex, it is obvious that they will exert a different effect before from the effect they exert after puberty. One of the greatest duties we have in practice today is to educate the public to the necessity of giving these extracts at a time when they will do good: in the paragraphs on the use of pituitary extracts we will recur to this aspect of the case.

One further general remark. The practitioner who begins to use these glands with great enthusiasm has in store for himself many disappointments. These disappointments may be due, aside from any gross mistakes in diagnosis, to one of four causes, which we cannot as yet control:

1. The symptoms present may be due to a dysfunction of the gland, not to either simple deficiency or to simple superabundance of normal secretion; that is, the gland may be pouring out a strange secretion from any produced in health.

2. The method of administration of the extracts may not be proper. In some instances oral administration may be totally ineffective. For all we know they should be given intravenously. This is not said here in a critical spirit. It is simply a suggestion, the outcome of thinking about my own failures. The proper method of administration of these extracts is still almost totally outside the field of our present knowledge.

3. The product given may be inert. These extracts deteriorate rapidly. We have no good methods of standardization.

4. The symptoms for which the patient is being dosed may not be the deficiency of the gland, the extract of which is being administered, at all. This mistake in diagnosis may be made, in the odor of sanctity—with the best information on our state of knowledge at present.

5. It may be too late. The bodily changes which have occurred may be fixed and use of the gland cannot cause retrogression—examples of this are treating cretinism after the third or fourth year, or Fröhlich's syndrome after the fifteenth year.

Below we will first record, in tabulated form, a brief resumé of what conditions the various gland extracts may reasonably be expected to benefit. This represents, I believe, the best conservative medical thought of the day, based upon careful clinical and experimental observation:

| | |
|---|---|
| I. Thyroid gland or thyroxin— | 1. Cretinism.<br>2. Myxedema.<br>3. Forme fruste of myxedema.<br>4. Obesity, particularly thyroid obesity.<br>5. Scleroderma. |
| II. Pituitary— | 1. Fröhlich's syndrome—preadolescent obesity, usually in males, with infantilism sexually, and tendency toward female type of body. (Possibly blindness).<br>2. Diabetes insipidus.<br>3. Pituitary amenorrhea, obesity, headache, etc. |
| III. Ovaries— | 1. Menopause—vasomotor changes.<br>2. Amenorrhea of some types.<br>3. Kraurosis of the vulva and other conditions where the circulation in the vulvae is insufficient.<br>4. Pernicious vomiting of pregnancy—possibly.<br>5. Eunochoid state in women—some cases. |
| IV. Testes— | No definite clinical symptom—complex yet proved in which feeding testicular extract is of any benefit. |
| V. Adrenal— | Addison's disease. (?)<br>Progressive muscular dystrophy. |
| VI. Islets of Langerhans— | Diabetes mellitus. |
| VII. Parathyroid— | Tetany. |
| VIII. Pineal gland— | Progressive muscular dystrophy. (?) |

## THYROID EXTRACT

On February 12, 1891, a woman aged forty-six was shown at a meeting of the Northumberland and Durham Medical Society. When she was forty-one or forty-two years of age her relatives noticed that she was becoming slow in speech and action and that the features were becoming enlarged and thickened and that the hands and feet were enlarging. Dr. George R. Murray, who showed the patient, announced that he intended to treat her by the administration of thyroid extract. This was begun some months later at which time the following notes on her condition were made:

"She complains of languor, a disinclination to see strangers, and great sensitiveness to cold. The temperature is subnormal and varies between 95.6° and 97.2° in the mouth. The pulse varies between 60 and 70. The face is blank and expressionless and the features are notably thickened. This change is well seen in the alae nasi and lips. The subcutaneous connective tissue of the eyelids is so swollen that she finds it difficult to look upwards.

"* * * The hands and feet are both enlarged; the former have that peculiar shape which has been described as spade-like. The skin is very dry, there is no perspiration, and the superficial layers of the epidermis are continually being shed as a fine white powder. The hair is very fine in texture and a considerable quantity of it has been lost.

"The experimental nature of the treatment was explained," Dr. Murray tells us, "and the patient, realizing the otherwise hopeless outlook promptly consented to its trial. In order to insure that the extract was properly prepared the thyroid gland was removed from a freshly killed sheep with sterilized instruments and conveyed at once in a sterilized bottle to the laboratory where the glycerin extract was prepared, as elsewhere described. This extract was afterwards in the British Pharmacopœia of 1898 as 'Liquor Thyroidei.'

"* * * In the treatment of this first case a hypodermic injection of 25 minims of the extract was given twice a week at first, and later on at longer intervals. The patient steadily improved and three months later, on July 13, the condition was thus described:

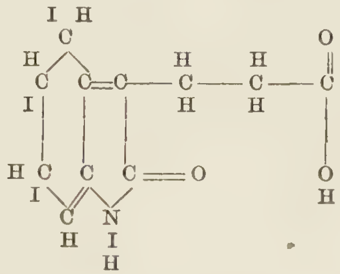
"The swelling has gradually diminished and has practically disappeared from the back of the hands, the skin over them being now loose and freely movable. * * * The swelling of the upper eyelids has diminished so much that she can look upwards quite easily. * * * The speech has become more rapid and fluent * * * and the memory has improved. * * * She has menstruated normally during the last six weeks at regular intervals. For the last four weeks the skin has been much less dry and she perspires when walking.

"After this the injections were given at fortnightly intervals, and later on, when the oral administration had been shown by Dr. E. L. Fox and Dr. Hector Mackenzie to be equally efficient, she took 10 minims by the mouth six nights a week, so that 1 drachm was consumed in the course of each week. On this dose she remained in good health and free from the signs of myxedema."

The patient continued to take liquid thyroid extract regularly until early in 1918, when it became difficult to obtain and she then used the dry extract. In 1919 she developed dropsy and died in May at the age of seventy-four.

From this, the first case of myxedema to receive thyroid extract, we may learn much as to its efficacy, the proper dosage, the length of time it will keep the patient in good condition, and the nature of the symptoms it will relieve. A careful consideration and review of the case will do more to fix these essential matters in the student's mind than pages of formal iteration of them.

A great step in advance was made by Kendall who in 1914 isolated in crystalline form the active constituent of the thyroid gland, to which the name thyroxin has been given. The chemical formula for it according to Kendall is:



Incidentally he found that the amount of the substance varies greatly in normal thyroids, in some glands being present in one part in 4000 and in other conditions in one part in 10,000 of fresh glands. This may explain why some preparations of thyroid gland are inert.

Using the determination of basal metabolism as the standard of therapeutic measurement, he found that if the basal metabolic rate of an individual is 30 per cent below normal, 10 mg. of thyroxin will raise it to normal: if the rate is 21 per cent below, 7 mg. of thyroxin will raise it to normal. Thus we see that it is absolutely specific in its action, and the dose can be determined with mathematical accuracy. It is the greatest stimulant to cell activity that we have.

As to dosage—the average daily exhaustion of thyroxin in the tissues is between 0.5 and 1 mg. thyroxin: in practice 1.6 mg. of thyroxin by mouth, daily, will be sufficient for most thyroidless individuals—myxedemas and cretins. The drug may be expected to act on the tenth day following administration. It may also be given intravenously. The amount to be so given depends upon the metabolic rate, an average dose being 3 mg. It is dissolved with the aid of a drop of 10 per cent sodium hydroxide in 1 c.c. water.

The average dose of thyroid extract is given by the Pharmacopoeia as 1½ grains. Experience indicates that no definite dosage can be set, but the necessity of the individual case must be determined. It has been used in smaller doses in obesity. Warnings are held out against its use in this way, but I must say that I have seen no harm come from its use in doses of 1 to 2 grains a day.

The treatment of cretinism with thyroid extract should be begun early in life. If delayed until after the third or fourth year it may not be successful. This should stimulate pediatricians to make an early diag-

nosis. The babies are usually very heavy at birth and such babies should be regarded with suspicion. Infants can be given ½ grain of the thyroid extract once daily, a child of two can have a grain a day, and older children two grains a day. While the bodily development of cretins is remarkable under thyroid feeding they seldom become mentally alert.

Among other conditions for which thyroid extract has been used is scleroderma. Byron Bramwell, I believe, was the first to use it. In some cases of the disease it acts most efficiently, in others, for no discernible reason, it is inert. In the successful cases the process is arrested but retrogression does not always occur.

## PARATHYROID EXTRACT, OR PARATHYROID HORMONE

Removal of the parathyroid glands results in a condition of chronic tetany or bilateral intermittent muscular spasms. The condition occurs in children with rickets and it is suggested by MacCallum that in these cases there is a parathyroid deficiency. The introduction of parathyroid hormone into the animal body causes a great stabilization of calcium in the blood serum. Rickets is known to be a disease of calcium deficiency, probably lack of calcium stabilization. The occurrence of spontaneous tetany in rickets therefore awakens interesting theoretical speculations. Other causes of tetany are discussed in Chapter XXII.

In 1925 J. B. Collip introduced the first effective extract of the parathyroid glands. Up to that time the use of calcium lactate was more certain in its effects on tetany than the exhibition of parathyroid, but since Collip's hormone has been introduced into practice, it will probably supplant the simple calcium therapy. Collip began by adopting the older methods of extracting fresh parathyroid glands of oxen with mineral acid at 100° C. and then purifying the product by various means, such as salting out the hormone with adherent substances, repeated isoelectric precipitation of protein-like fractions containing the hormone, solution of the active principle in alcohol, etc. The hormone is standardized and the dosage calculated in units. A unit is "one hundredth of the amount of extract which will produce an average increase of 5 mg. in the blood-serum calcium of normal dogs of approximately 20 kg. weight, over a period of fifteen hours." Subcutaneous administration of the parathyroid hormone in both normal and parathyroidectomized dogs produces a great rise of blood-serum calcium. The normal blood serum calcium is about 10.5 mg. per hundred cubic centimeters. Under parathyroid administration the figures may rise to 20 mg. per 100 c.c. or even higher. As hypercalcemia occurs a definite train of symptoms arises which eventually end in death. There is danger, therefore, in its indiscriminate use. In the human subjects which have been studied, the early symptoms of hypercalcemia recorded—when the blood-serum cal-

cium rose above 11.9 mg. per 100 c.c.—were listlessness and lack of energy. Later in animals, depression, anorexia, ataxia, vomiting and bloody stools are observed.

The clinical conditions in which it has been used are infantile tetany in rickets and other forms of tetany with a low calcium content of the blood. Davidson reported its use in a girl with myxedema, nephrosis, and tetany. Lisser and Shepardson reported the case of a woman who had three parathyroids removed with an adenomatous goiter. The dosage ranged from 12.5 to 50 units. Calcium lactate is usually administered by mouth along with the subcutaneous administration of the parathyroid extract for obvious reasons. In hemorrhage from various causes—pulmonary tuberculosis, bleeding fibroids, postpartum—Gordon and Cantaran have used it in 347 patients with 304 good results. They also recommend it in jaundice as a preoperative measure.

The dosage, as recommended by Hoag and Rivkin, is five units per kilogram of body weight for each milligram of calcium rise desired. This is to be given subcutaneously in divided doses every four to six hours during twenty-four to thirty-six hours. Thus an infant weighing 8 kg. with a blood serum calcium of 7.5 mg. per 100 c.c. could be given $2.5 \times 8 \times 5 = 100$ units in twenty-four hours, in four doses of 25 units each, six hours apart. The distinct dangers of overdosage indicate the necessity of control by blood-serum calcium determinations: values above 1 mg. per 100 c.c. are undesirable.

## PITUITARY GLAND EXTRACT

The pituitary gland consists of three parts—an anterior lobe which is, upon histologic examination, seen to be epithelial in structure, a posterior lobe, which contains largely nervous tissue—neuroglia cells and fibers—and an intermediate lobe, which, like the anterior lobe, from which it arises embryologically, is made up of epithelial cells. In the structure of the posterior lobe hyaline or colloid bodies occur and they are probably the source of the internal secretion of the lobe.

Both the anterior and posterior lobes unquestionably pour an internal secretion into the blood stream. We know little definitely about the functions of the secretion, except that we know the symptoms of lack of it or increase of it. The two lobes appear to be quite as distinct as any other ductless glands—we know syndromes in which each secretion separately seems to be deficient and in which each seems to be increased. At other times the symptoms indicate bilobular involvement, and the anatomical proximity of the two lobes makes the double involvement by tumors and inflammatory processes easy.

In brief the symptoms of lessened secretion of the pituitary gland may be summarized thus:

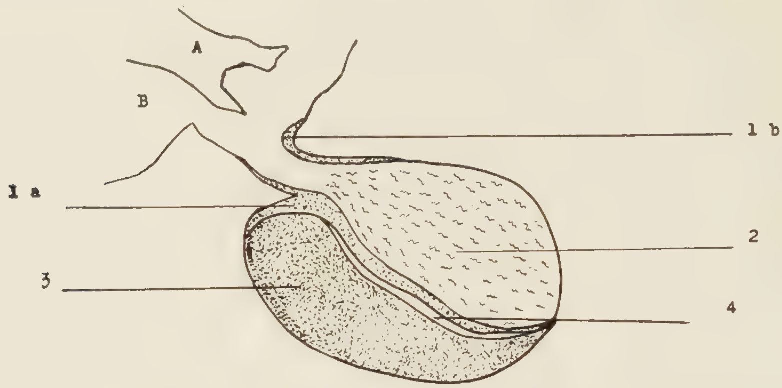



Fig. 22.—Diagram of pituitary gland, median sagittic (after Herring).
*A*, Third ventricle; *B*, optic chiasma; *1a*, pars intermedia; *1b*, pars intermedia extending around the neck of the pars nervosa; *2*, posterior lobe or pars nervosa; *3*, anterior lobe or pars glandularis epithelialis; *4*, interglandular cleft between intermedia and epithelialis.

Anterior Lobe Hypoactivity.

*Preadolescent*—

Lorain-Levi syndrome. Undergrowth all bones. Small stature, torso longer than legs. Span less than height. Small head, feet and hands. Small sella turcica. Pointed chin. Infantile genitals. Menstrual disturbances. Amenorrhea. Impotence or sterility. Upper incisors enlarged. Low blood pressure.

*Postadolescent*—

Undergrowth of short and flat bones. May be tall. Small tapering fingers. Broad pelvis. Genu Valgum. Amenorrhea. Impotence. Loss of libido. Hypotension.

Posterior Lobe Hypoactivity.

Decreased Basal Metabolism.
Increased carbohydrate tolerance.
Obesity—girdle mons and mammae.
Polyuria—pars intermedia also involved.
Somnolence.
Subnormal temperature.

Pars Intermedia Hypoactivity.

No definite symptoms known.

Bilobar Hypoactivity.

*Anterior and posterior lobes.* Fröhlich's syndrome. Obesity. Sexual infantilism. Feminine type of body and mind in a boy. Somnolence. If tumor is present, blindness.

*Posterior lobe and pars intermedia.*

Diabetes insipidus.

Hyperactivity of the gland results in syndromes such as gigantism and acromegaly with which we are far better acquainted, and in which we are much more certain that the symptoms are due to actual disease (hypertrophy, etc.) of the gland.

In treating the syndromes of hypoactivity we use either the extract of the anterior lobe or the extract of the posterior lobe. The latter has for some time been in the Pharmacopoeia and is widely marketed in liquid form under the name pituitrin. Its pharmacologic effect in stimulating the uterus and intestines to contraction is quite distinct from its use as a substitute for internal secretion. It may be given hypodermically or in dried form by mouth. The dried powdered anterior lobe is now marketed by several firms.

We know next to nothing about the dosage of these bodies. In syndromes in which it is supposed that the secretion of the gland is defective, it is usual to give the extracts either singly or combined in gradually increasing doses until one of three things happens; either improvement occurs, the patient becomes exhausted, or the physician becomes exhausted.

In my personal experience the second possibility usually is the one that occurs first. The primary dosage of anterior lobe substance is usually 5 grains. The posterior lobe dried extract should not be started at a higher dose than $1/10$ grain.

While pituitary gland has been tried in many symptom-complexes which may, within reason, be supposed to be due to hypoactivity of the gland, there are two syndromes in which its use has been fairly well standardized.

*Diabetes insipidus* responds in about 90 per cent of cases to the hypodermic administration of pituitrin as ordinarily put up by manufacturers for obstetrical and surgical use—in 1 c.c. doses. No definite pathology has been proved for diabetes insipidus. While it responds to the posterior pituitary extract (in which is usually mixed pars intermedialis extract), and the deduction might be that it is due to hypofunction of the posterior and intermediate lobes of the gland, there has not been, it seems to me, clear cut proof of this. However the pituitrin does keep the symptoms under control. Rowntree and Englebach have each had definite cases of diabetes insipidus with a daily output of urine of 4000 to 5000 c.c. brought down to an output of 1000 to 1500 c.c., at the same time raising the specific gravity and kept there for weeks upon regular administration of pituitrin. When the pituitrin is withheld the output again rises. Rowntree reports that the pituitrin must be given hypodermically, while Englebach reports success with oral administra-

tion. The only case in which I have used it did not respond to oral administration but began to improve immediately upon hypodermics. A single dose of pituitrin will control the urinary output for about eight hours, so that another administration has to be given. Bab has reported that pituitrin will concentrate the urine of normal persons, raising the specific gravity from an average of 1022 to an average of 1024, 1026 and 1028. Englebach and Tierney point out three signs or symptoms which mark the physiologic limit of tolerance of the administration of pituitrin. One is the intestinal, consisting of abdominal cramps, one is the vascular consisting of transient pallor coming on soon after the hypodermic administration of the drug, and the third is general consisting of a prolongation of the condition of pallor, with tachycardia and even syncope. The dosage of the drug can be raised, in endeavoring to control the symptoms, up to the point where one of these symptoms is present.

*Fröhlich's syndrome*, due either to hypoactivity of the anterior lobe, or of both lobes, is a fairly frequent condition. It begins before adolescence and occurs mostly in males, though it is found in females. The boys are fat, feminine, weak, and misunderstood. Their manifest deformities are regarded by their parents, teachers and playmates as natural and inevitable variations of human structure, rather different but within the normal limits. They are sissy because they are sissy: some boys are sissy. They are fat because some people are fat. They are weak and do not play *boys'* games because they are sissy. That is the usual view. It is not commonly recognized that they are definitely in a mutual deficiency group, that the deficiency is an affair of internal secretion and that treatment to be effective at all must be begun early in life. Reasoning from our experience with cretins we must get these people early. Later in life, while we may relieve symptoms such as headache and polyuria, we are not able to correct the gross deviations from normal contour and structure. A heavy obligation is laid on the medical profession to educate parents and teachers to the possibility of doing something for them. They are far more numerous than cretins. Everyone can remember back in his school days one such fat sissy boy: their lives are tragedies. Whether treatment can help them or not we do not yet know. But we do know enough about the etiology in general; we have had sufficient analogous experience in the treatment of cretins to lead us to suppose that if treatment is to be of any value it must be begun early.

In treating many pituitary syndromes, it is well to try the administration of thyroid gland, adrenal gland and possibly ovarian or testicular extract along with the pituitary powder.

## THE PINEAL GLAND

Tumors of the pineal gland in boys result in a precocious development of the penis, testicles, and of secondary sexual characteristics such as the depth of voice, hair, etc. No tumor of the pineal, of which I can find record, has been studied in a female. The gland undergoes involution after the seventh year, so that it is reasonable to suppose that its secretion exerts a restraining effect upon the development of the sexual organs, though whether the tumors stimulate or destroy its secretion is still speculative. Feeding experiments with pineal substance are thoroughly contradictory. Most reporters state that no results occur, while McCord found that feeding pineal gland extract to young guinea pigs resulted in an extraordinary premature increase in the testes and earlier sexual maturity in males and females.

The gland extract has not been used much, in therapeutics. Timme has reported cases of progressive muscular dystrophy, in which the pineal gland was supposed to be diseased, but he did not record the result of feeding the gland.

## THE OVARY

Ovarian substance has been prepared and given in three forms: (1) whole ovarian extract, (2) the extract of the corpus luteum and (3) ovarian residue, or that portion of the ovary which remains when the corpus luteum has been removed.

These substances have been used in a large variety of conditions. The list which I have put down on page 225 represents those syndromes which careful and critical workers have concluded are most likely to be benefited by their use.

The menopause, whether artificial or natural, is the condition in which the use of ovarian extract has been most successful. The vasomotor changes particularly, the annoying flushing of the face, the sense of heat and alternately of cold, are very greatly relieved in most cases, in some entirely aborted by the regular use of ovarian extract throughout the period. The dosage of the whole gland in these cases is 5 grains three or four times daily. Corpus luteum extract may be given in the same dosage and often works quite as well.

In some cases of amenorrhea it is of value. The cases for treatment must be carefully selected. There must be no organic uterine disease. The patients most likely to be benefited are in adolescence. There may be evidences of other endocrine gland dysfunction as in the bodily habitus. The ovarian extract may act better combined with pituitary and thyroid extract.

Ovarian extract too seems to have a definite action upon the vasomotor changes in the vulva. In certain atrophies and skin diseases of vasomotor origin—kraurosis vulvae, pruritus, etc.—it is helpful and curative.

The extract of corpus luteum has been widely used in the pernicious vomiting of pregnancy. At times it seems to work well, at others it is inert. Judgment is very difficult here. If the patient stops vomiting it does not necessarily mean that it was the corpus luteum that stopped her. And there are enough cases in which no result occurred from the use of the corpus luteum to make us wonder whether any action really attributable to the extract ever occurs. Corpus luteum may be given by mouth or hypodermically.

In the list on page 225 sterility does not appear. For a time there was great enthusiasm for the treatment of functional sterility by the use of ovarian extract: but the results have been disappointing. One reason for this may be that the other ductless glands are so important in activating the internal secretion of the ovary: for instance the woman with myxedema usually does not menstruate, and there are forms of pituitary amenorrhea and dysmenorrhea.

The influence of the ovary at different stages of the ovarian cycle and during pregnancy must be understood in order to have an intelligent and constructive knowledge of the administration of ovarian extract. The ovary is covered with a layer of epithelium, the germinal epithelium, which is embryologically continuous with the tubal and uterine mucosa. Beneath this is a connective tissue layer and in this lies the parenchyma of the ovary in which the follicles rest and develop into mature ova. It is estimated that at birth the individual is endowed with about 30,000 of these follicles: it is probable that no new ones are developed after birth. The ripening of the follicles begins soon after birth or even during intrauterine life. Up to the time of puberty the ripening process is abortive. From the time of puberty up to the time of the menopause, except during pregnancy, the process of ripening goes on continuously, at least one follicle ripening every month.

When the primordial follicle begins to ripen the surrounding epithelium begins to proliferate, the cells multiplying by mitosis, and piling up around the ovum. In this mass of cells, a vacuolization appears and a clear space filled with liquid, the liquor folliculi. This body—the graafian follicle—moves towards the surface of the ovary where it appears as a small cyst. Finally it ruptures through the wall, the ovum is discharged and begins its journey in the tube toward the uterine mucosa. Late in its development the graafian follicle secretes a hormone which influences the uterine mucosa to active proliferation, forming an epithe-

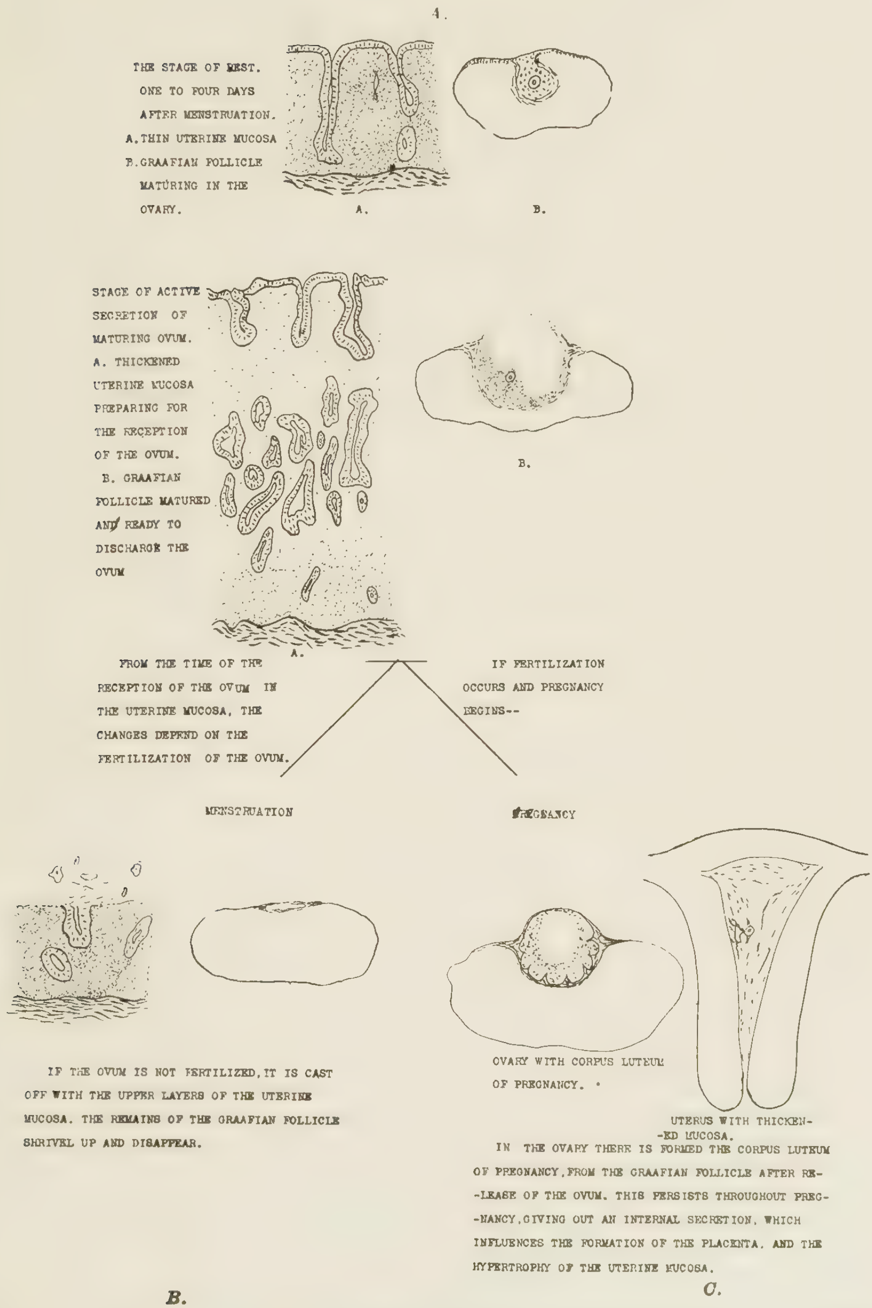



Fig. 23.—Diagram to illustrate the influence of the ovary on the functions of menstruation and the condition of pregnancy. *A*, *B*, and *C*.

lial bed for the reception of the ovum should it become impregnated. After the ovum escapes, the remnant of the graafian follicle forms into the corpus luteum; the follicle fills with a coagulum and the cells of the wall of the follicle hypertrophy and form the yellow membrane which gives the corpus luteum its name. It is supposed that internal secretion from the corpus luteum causes the uterine mucosa to remain turgescent.

From this point one of two paths of development may take place. If the ovum is not impregnated, the corpus luteum begins to shrink and finally atrophies. Its secretion disappears and the turgescent uterine membrane and the ovum are discharged in the form of the menstrual flow. The uterine membrane once more shrinks until the development of the next graafian follicle reaches the stage, some twenty-one days later, that causes a renewed overgrowth.

If fertilization of the ovum occurs it has the power, possibly through the development of a hormone of its own, to cause the corpus luteum to persist and it develops into the corpus luteum of pregnancy, which persists all the way through or nearly all the way through a pregnancy. Its continued secretion causes the uterine mucosa to remain and to develop. Later the fetal coverings and the placenta produce a hormone identical in its action with the corpus luteum. The corpus luteum also inhibits ovulation so that no new graafian follicles develop during pregnancy. The experimental work of Leo Loeb has shown that corpus luteum extract experimentally will do this and will also cause an overgrowth of the uterus in a nonpregnant animal.

There is some difference of opinion as to whether the whole ovary, the corpus luteum, or the ovarian substance without the corpus luteum should be used as the substance representing the internal secretion of the ovary for therapeutic purposes. J. C. Hirst believes each one has its own indications. Considering the resumé of the sexual cycle as outlined above, it is evident that the corpus luteum presides over the changes in the uterine mucosa at the menstrual period; and over the adjustment of the body to the early stages of pregnancy—the development of the placenta, increase in size of the uterus, etc. But it is that part of the ovary, aside from the corpus luteum, which must initiate the onset of puberty, and start the development of graafian follicles; probably, also, the lack of this residue-hormone initiates the onset of the menopause.

The corpus luteum then, according to Hirst, is indicated in (1) the nausea of pregnancy, (2) habitual abortion without demonstrable cause (based upon the theory of the rapid absorption of the corpus luteum of pregnancy), (3) menopause (not so effective as the whole ovary), (4)

scanty menses of girls, (5) pruritus vulvae, and (6) sterility (other gynecologists do not agree with Hirst about this last).

The whole ovary is used in (1) the menopause both natural and surgical.

Ovarian residue is used in (1) infantilism, (2) the late development of puberty, and (3) menorrhagia of young girls.

Much of what has been said above concerning ovarian substances is plainly theoretical. The whole subject is under debate and exceptionally earnest partisans can be found on both sides of all the proposals just suggested. Allen, Pratt and Doisy began in 1923 to publish reports on an ovarian follicular hormone, which they derived from the graafian follicle. In animal experiments its action is non-species active, the follicular material from sows' ovaries inducing changes in the vaginal epithelium of rats and mice from which the ovaries had previously been removed. During their numerous experiments Allen, Pratt and Doisy found that the stages of the estral cycle in animals were characterized by changes in the nature of the vaginal secretion. This led to the setting up of a unit of measurement of the effectiveness of a preparation—the rat unit, it being the quantity of material necessary to induce estrus as judged by the smear of the vaginal secretion in an ovarectomized sexually mature rat, weighing 140 gm. within three days. This hormone is now on the market. It has been used clinically in the menopause, artificial and natural, amenorrhea, scanty menstruation, and immaturity. Full reports as to its therapeutic success are lacking.

## THE TESTES

There is no clinical condition in which the feeding of testical extract has been shown to be of any value. There are several cases on record of surgical implantation of testicular tissue, in cases of castration or destruction of the testis (as in the orchitis of mumps, Morris' case) in boys. They have been moderately successful. Stanley has performed testicular implantation upon prisoners in the San Quentin penitentiary for such diverse affections as asthma, paralysis agitans, dementia precox, acne, paranoia, senility, rheumatism and diabetes. The procedure, according to Stanley's report, seems to have mitigated the rigors of prison life as the patients experienced a feeling of buoyancy, a new joy of living, increased mental activity and improvement in vision, or at least so they told the medical officer of the prison. The implants were taken from rams, goats and boars and placed in a paraffin syringe, being injected into four places in the abdominal wall, 1 gram in each place.

## ADRENAL EXTRACT

One of the earliest contributions to modern endocrinology was Addison's description of the syndrome known by his name and due to destruction—usually tuberculous—of the adrenal glands. The diagnosis of Addison's disease cannot be made definitely unless the pigmentation is present, the blood pressure is low, there is evidence of tuberculosis either general or local, and there is emaciation and easy fatiguability. The use of adrenal extract has not proved of much value, neither has adrenalin.

Occasionally this is not true. An instructive account of a case of Addison's disease is that of Dr. A. L. Muirhead. The author himself was the patient. He had a tuberculosis of the left kidney for which a nephrectomy was done in 1918. Two years later, he developed great weakness and prostration, followed by bronzing of the skin of the face and hands. After trying dried adrenal gland extract by mouth and adrenalin by mouth without good effect, his symptoms improved on the hypodermic use of adrenalin. The bronzing disappeared, and the extreme sense of weariness was lost, so that he could do some moderate exercise without fatigue. He found that the rectal administration of 10 grains of dried suprarenal gland, once a day, was the most satisfactory way for him to take the extract. If more than 0.2 c.c. of a 1:1000 solution of adrenalin were given he developed muscular trembling, and other disagreeable symptoms. The rectal administration of the drug caused tenesmus but this could be averted by a great dilution of the drug. The patient kept well and free from pigmentation upon continued administration of the gland extract in some form, but as a later report by his physician, Dr. Rowntree, shows, died of asthenia in 1922.

Hypersecretion of the adrenals in women results, in some cases, in pseudohermaphrodism. A case reported by Codman was in a woman who had always had a decidedly masculine habit, who had hair on the chin sufficient to require shaving, and hair on the chest, whose menses were peculiar, watery instead of bloody, and whose clitoris was the size of a boy's penis. She developed a tumor of the adrenal gland, a hypernephroma, which was removed surgically. Afterwards her appearance was strikingly changed. The hair disappeared from her chin and chest, the menses became regular and the breasts began to develop into the feminine form.

One aspect of the function of the adrenals is important in view of the use of the extract in some cases of muscular dystrophy. Cannon, after numerous experiments, believes that adrenal secretion is a great

activator of striped muscles, that it prevents fatigue of these muscles and that increasing amounts of adrenalin in the blood allows the muscles to work at high power over longer and longer periods. The adrenals are stimulated by fear; Cannon found that by frightening laboratory animals he was able to increase the amounts of adrenal secretion in their circulating blood. Thus fear results in a defense reaction. It causes more adrenal secretion to be poured into the blood. The animal in running from the object of his fear is furnished a substance which increases the irritability of his muscles and at the same time allows them to work at high power over a longer interval.

## SUGGESTED USES OF OTHER GLAND EXTRACTS

**The Thymus** has been recommended in Mongolian idiocy, other forms of insanity, in hypertrophic arthritis, and arthritis deformans on the theoretical ground that it atrophies at the time bony development begins and thus influences ossification.

**Extract of the Placenta** has not yet been put upon a scientific basis for therapy. It is interesting that Allen found the follicular ovarian hormone to be present in great quantity in the placenta. He also found increase in the thickness of the dermis in the nipple area to occur after injection of the ovarian hormone. The use of placenta as a galactagogue has not, however, been submitted to careful investigation and check.

**Mammary Extract** has been recommended to control uterine bleeding. There is no doubt that the mammary gland has some effect on the uterus, but the success of the procedure has not been marked.

## THE TREATMENT OF SYNDROMES OR DISEASES BY PLURIGLANDULAR THERAPY

It is quite reasonable, considering how closely correlated, and interdependent the ductless glands are, that syndromes or diseases due to pluriglandular dysfunction should be found. However, no clear-cut syndrome of this character has been accepted. Certain conditions have been treated by pluriglandular therapy, however.

**Defective Children.**—No forms of defect in children except cretinism and Fröhlich's syndrome have been benefited by the use of ductless gland extracts. Mongolian idiocy would seem to be the most hopeful field because it is not a distinctly degenerative form of deficiency, children of the same family as Mongolian idiots being perfectly normal. Cases of this kind have been tried on every gland extract given every way and with every conceivable combination of pluriglandular therapy, entirely without success.

**Progressive Muscular Dystrophy.**—The various forms of muscular atrophy and dystrophy have been carefully studied of late years from the point of view of their metabolism. Janney, Goodhart and Isaacson found that the patients had a lowered amount of blood sugar, a marked decrease of preformed creatinin, abnormal presence of creatin in the urine, a normal amount of creatin in the blood, and decreased glucose utilization. Interpreting these findings we know that lowered amounts of blood sugar are found in other endocrine diseases—myxedema and cretinism; in cretinism, too, creatin has been found in the urine. Creatin is never found in normal urines. It is closely connected with the function of muscular contraction. The amount of creatinin in the urine may be taken as a measure of muscular work.

Considering for a moment the hypoglycemia as a symptom of endocrine disorder, let us remember that glucose is the source of energy for muscular contraction. As muscles contract glucose is rapidly used up; it must be supplied from the glycogen store of the liver. Such diseases as Addison's disease, phosphorus poisoning, etc., which reduce blood sugar cause profound myasthenia or muscle weakness, a symptom of progressive muscular dystrophy. Under normal circumstances the glycogen of the liver rapidly furnishes blood sugar and maintains it at a fixed level. Hypoglycemia results only from a loss of the power of the liver to keep pace with the needs of muscles for glucose. Inasmuch as in progressive muscular dystrophy there is no lack of carbohydrate in the food and there is no loss of power to convert glucose in the muscles (as there is in diabetes) it is supposed that the function of glycogenesis, controlled it is believed by the adrenals and other endocrine glands, is at fault. A rise in blood sugar occurs in muscular dystrophies following the administration of adrenalin or epinephrin.

Usually, more than one gland must be administered. thyroid—pituitary—adrenal—pineal and testicular extract mixed, or some such combination as trial treatment of the case shows to be the best.

## References

Allen, Pratt, and Doisy: The Ovarian Follicular Hormone, Jour. Am. Med. Assn., lxxxv, No. 6.

Bab: Hypophysis as a Regulator of Diuresis and Urinary Specific Gravity, München. med. Wchnschr., 1916, lxiii, 1685, 1721, 1758.

Bandler, Willys: The Endocrines, Philadelphia, W. B. Saunders Co.

Barker and Mosenthal: Control of Diabetes Insipidus by Subcutaneous Extracts of Hypophysis Cerebri (pars posterior and pars intermedia), Jour. Urology, October, 1917, i, No. 5.

Biedl: Internal Secretions, New York, Wm. Wood and Company.

Collip: The Extraction of Parathyroid Hormone, Jour. Biol. Chem., March, 1925, lxiii.

Cushing: The Pituitary Body and Its Disorders, Philadelphia, J. B. Lippincott Co.

Davidson: A Case of Adolescent Myxedema, Canadian Med. Assn., Jour., July, 1925, xv.

Englebach and Tierney: Disorders of the Pituitary Gland, Tice's Practice of Medicine, Vol. III. The report of original cases is splendid, though deficient in autopsy material.
Frank: The Ovary and the Endocrinologist, Jour. Am. Med. Assn., January 21, 1922, lxxviii, No. 3.
Frank: The Placenta Regarded as a Gland of Internal Secretion, Surg., Gynec. and Obst., September, 1917, xxv, 329.
Graves: Chapter on Ductless Glands in Graves' Gynaecology. Also not based on autopsy material but better digested clinical experience than other gynecologists.
Hoag and Rivkin: Treatment of Infantile Tetany, Jour. Am. Med. Assn., May 1, 1926, lxxxvi.
Hirst: The Comparative Value of Whole Ovarian Extract, Corpus Luteum Extract, and Ovarian Residue in Menstrual Disorders, New York Med. Jour., October 5, 1921.
Jenny, Goodhart and Isaacson: The Endocrine Origin of Musclar Dystrophy, Arch. Int. Med., 1916, p. 188.
Kendall: The Active Constituent of the Thyroid, Jour. Am. Med. Assn., September 14, 1918, lxxi, No. 11.
Lisser and Shepardson: A Case of Tetanic Parathyreopriva Treated with Collip's Parathyroid Extract, Jour. Am. Med. Assn., November 21, 1925, lxxxv.
MacCallum and Voegtlin: Relation of the Parathyroid to Calcium Metabolism and Tetany, Bull. Johns Hopkins Hosp., 1908, xix, 91.
Muirhead: Addison's Disease—a Personal Experience, Jour. Am. Med. Assn., March 5, 1921, lxxvi, No. 10.
Murray: Life History of the First Case Treated by Thyroid Extract, Brit. Med. Jour., March 13, 1920, No. 3089.
Plummer: Interrelationship of the Function of the Thyroid Gland. Jour. Am. Med. Assn., July 23, 1921, lxxvii, No. 4.
Pratt and Allen: Clinical Tests of the Ovarian Follicular Hormone, Jour. Am. Med. Assn., June 26, 1926, lxxxvi, No. 26.
Rowntree: Diabetes Insipidus, Oxford Medicine.
Sajous, E. de M.: Internal Secretions and the Principles of Medicine. Articles on Ductless Glands in Tice's Practice of Medicine, Vol. viii.
Schroeder: Monatschr. f. Geburtsh. u. Gynäk., 1914, xxxix, 3.
Stanley: Testicular Substance Implantation-Endocrinology, November, 1921, v, No. 6.
Timme: Progressive Muscular Dystrophy as an Endocrine Disease, Arch. Int. Med., 1907, xix, No. 1, p. 104.

## CHAPTER V

## DIETETICS

Food may be varied to suit a patient's requirements in five ways:

1. The amount of each feeding.

2. The number of calories per day.

3. The intervals between feedings, and the time (regularity) of meals.

4. The relative quantities of the principal foodstuffs—carbohydrates, proteins and fats—may be changed, or, temporarily, one may be entirely deleted.

5. The amounts of the absorbable and nonabsorbable parts of foods may be increased or decreased; similarly the secretion-stimulating and nonstimulating parts of foodstuffs may be increased or decreased.

It is, I believe, a fair criticism of therapeutists generally that they pay attention to the total caloric content of a diet, to the neglect of the amount of each meal, and that they emphasize the absorbable and nonabsorbable and secretion-stimulating and nonstimulating content of foods, while not taking advantage of the value to be derived from defining the intervals between meals and the regular time of meals.

### I. THE PLACE OF DIET IN THERAPEUTICS

The value of diet generally as a therapeutic procedure may be judged from the list of diseases in which it is useful.

1. Diseases in which diet is practically the entire treatment:

Pernicious anemia.
Obesity.
Gout.
Scurvy.
Infantile marasmus and intestinal disturbances.

2. Diseases in which diet plays a very important part, in conjunction with other treatment:

Diabetes.
Gastric and duodenal ulcer.
Gastric disturbances of secretion.
Enteroptosis.
Constipation.

Diarrhea.
Appendicitis.
Intestinal obstruction and acute abdominal crises generally.
Tuberculosis.
Typhoid fever, and acute fevers in general.
Nephritis.
Hypertension.
Thyrotoxicosis.
Chlorosis.

3. Diseases in which diet plays a secondary part:

Skin diseases.
Kidney stone.
Gallstones.
Heart disease and cardiac dropsy.
Jaundice.
"Rheumatism."
Cirrhosis of the liver.

## II. PRINCIPLES OF FOOD CHEMISTRY AND NUTRITION

There are some underlying facts and principles of the composition of foods and their energy value, of the energy requirements and tissue requirements of the body, and of the fate of foods in the animal body which every student and practitioner should have familiarly in mind. An extremely condensed and dogmatic outline of them is subjoined.

### A. The Two Functions of Food

1. To replace tissue loss.
2. To furnish fuel and energy.

### B. Composition of Foodstuffs

All foods are made up of varying proportions of the following substances: carbohydrates, fats, proteins, water, inorganic minerals and salts, and certain nitrogenous substances called vitamines. The human body is made up largely of proteins, fats, inorganic minerals and salts, water, and to a small extent of carbohydrates (mostly in the form of glycogen in the liver); there probably are vitamines also in the tissues, although the amount, by weight or volume, is negligible.

1. **Carbohydrates.**—Carbohydrates are widely distributed in living tissues, especially of plants. Broadly speaking they are the source of all the energy of plant and animal life. Compared to fats and proteins,

they are of relatively simple chemical composition. A simple sugar, or monosaccharide, may be defined as an aldehyde alcohol or ketone alcohol of the aliphatic series, the molecule of which contains one carbonyl and one or more alcohol groups, an alcohol group being always adjacent to the carbonyl group. Carbohydrates therefore do not contain necessarily any nitrogen. They have been classified as monosaccharides, disaccharides, trisaccharides, tetrasaccharides and polysaccharides. Glucose and fructose are examples of monosaccharides; lactose and maltose examples of disaccharides; and starch, cellulose and glycogen of polysaccharides. Glucose, or grape sugar, occurs abundantly in fruit and plant juices and is the form in which most carbohydrates are ultimately absorbed, after digestion; so that it is estimated that over half the energy manifested in the human body is derived from the oxidation of glucose (although it may not actually be oxidized directly as such in the human body). Fructose also occurs in plant juice, fruits and honey, often in association with glucose. Sucrose, or cane sugar, is probably the most familiar example of a pure carbohydrate used in daily life. On hydrolysis it yields one molecule each of glucose and fructose. Glycogen, sometimes called animal starch, is a normal constituent of the liver and is the form in which carbohydrate energy is stored in the animal body. Starch is the form in which most plants store the greatest part of their carbohydrates. On hydrolysis, by means of acid, it gives first mixtures of dextrose and maltose and finally, as an end product, glucose alone. Cellulose, is the chief constituent of the walls of plant cells generally. It is resistant to the action of digestive enzymes and usually passes through the digestive tract unchanged.

2. **Fats.**—Fats occur in foodstuffs of both animal and vegetable origin. Chemically they are glyceryl esters of fatty acids. In the animal body they are built up largely from carbohydrates. However, carefully conducted feeding experiments in which fat alone was used upon previously starved animals have demonstrated conclusively that fat can be built up from fats in the diet; I refer to the experiments of Monk and Hoffman as quoted by Sherman. In the animal body fat represents the ultimate storage of fuel, and fat tissue, as tissue, is the most inert of body structures. But it, also, joined with protein, is found in the composition of muscle and nervous tissue. Fat also has an important function in giving support to various structures, such as the kidneys, and form and contour to the body.

3. **Proteins.**—The proteins are largely found in animal food, although they are constantly present in plants, and some plant foods, such as peas, beans and nuts, contain a relatively large proportion of protein. Chemically they are very complex. The total number of proteins in

nature is probably very great, and only a comparative few—about 60—have been isolated sufficiently to warrant description. None of these even have been completely analyzed. But, so far as analysis has gone, most proteins are anhydrides of an amino-acid. They contain, then, carbon, hydrogen, oxygen, nitrogen, and usually sulphur and phosphorus.

Amino-acids have all certain characteristic points of structure in common. Each contains an amino group ($NH_2$) with a basicity like that of ammonia, and an acid group (COOH) with an acidity like that of acetic acid. A central carbon atom is the connection between all parts of the molecule. A typical amino-acid then has this basis:

$$\begin{array}{rcl} & \text{Distinguishing group} & \\ & | & \\ \mathrm{HOOC—} & \mathrm{C} & \mathrm{—NH} \\ & | & \\ & \mathrm{H} & \end{array}$$

Add to the above a certain group and we have the structural formula for arginine.

$$\begin{array}{rcl} & \mathrm{NH_2} & \\ & | & \\ & \mathrm{C} & \mathrm{—NH} \\ & | & \\ & \mathrm{CH_2} & \\ & | & \\ & \mathrm{CH_2} & \\ & | & \\ & \mathrm{CH_2} & \\ & | & \\ \mathrm{HOOC—} & \mathrm{C} & \mathrm{—NH} \\ & \mathrm{H} & \end{array}$$

The amino-acids of common proteins are as follows:

*Acid-amino-acids*—

Asparic acid—amino-succinic acid.

Glutamic acid amid—amino-glutaric acid.

*Neutral amino-acids*—

*a.* Containing only aliphatic chains—

Cysteine—alpha-amino-Beta-thio-lactic acid.

Glycine—amino-acetic acid.

Serine—alpha-amino-Beta-hydroxy-propionic acid.

Alanine—alpha-amino-proprionic acid.

Valine—alpha-amino-isovaleric acid.

Leucine—alpha-amino-isocaproic acid.

*b.* Containing pyrrolidine rings—
Oxyproline—
Proline—pyrrolidin-carboxylic acid.

*c.* Containing benzene rings—
Tryptophane—alpha-amino-beta-indol-propionic acid.
Thyosine—oxyphenyl-alpha-amino-propionic acid.
Phenylamine—phenyl-alpha-amino-propionic acid.

*Basic amino-acids*—
Histidine—alpha-amino-beta-imidozal-propionic acid.
Lysine—alpha-epsilon-diamino-n-caproic acid.
Arginine—guanidino-alpha-amino-valeric acid.

As foodstuffs proteins are used largely to replace tissue waste in the animal body. They may be used, of course, for fuel, and in those individuals whose diet is largely carnivorous, undoubtedly are used as such,

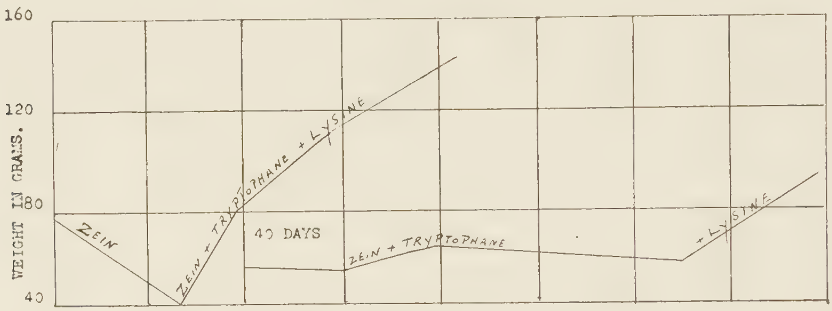



Fig. 24.—Showing the effect of adding tryptophane, or tryptophane and lysine to a diet containing zein as the sole protein.

but the body can much more easily utilize carbohydrates and fat for this so their primary use is as tissue replacement. This is a function which neither carbohydrates nor fats can perform, as neither of them can be broken up into the necessary radicles.

Familiar examples of pure protein foods are not frequent—perhaps egg white is the only one in the average dietary. Casein of milk is pure protein, but in milk is associated with carbohydrate and fat. Meats—animal flesh of all kinds—are largely protein, though associated with fat. Some vegetables have a large amount of protein—as wheat proteins (leucosin and glutelins), corn protein (zein), pea protein (legumelin).

Animals can exist upon either animal or vegetable protein. It is an interesting question as to exactly what portions of the complex protein radical are required in metabolism and in growth. Osborne and Mendel have conducted a long series of most illuminating investigations to answer this and similar questions. It is work which should be familiar

to all practitioners because it answers the problem of what proteins are sufficient to maintain growth and what to maintain life.

Osborne and Mendel were particularly interested to determine which of the known amino-acids of common proteins were the important ones in maintaining life and promoting growth.

In their experiments they used growing white rats, and fed them either pure proteins or proteins which contained none of some particular amino-acid. They believe (their experiments are not yet concluded) that *glycine* is not necessary for either growth or maintenance. *Tryptophane*

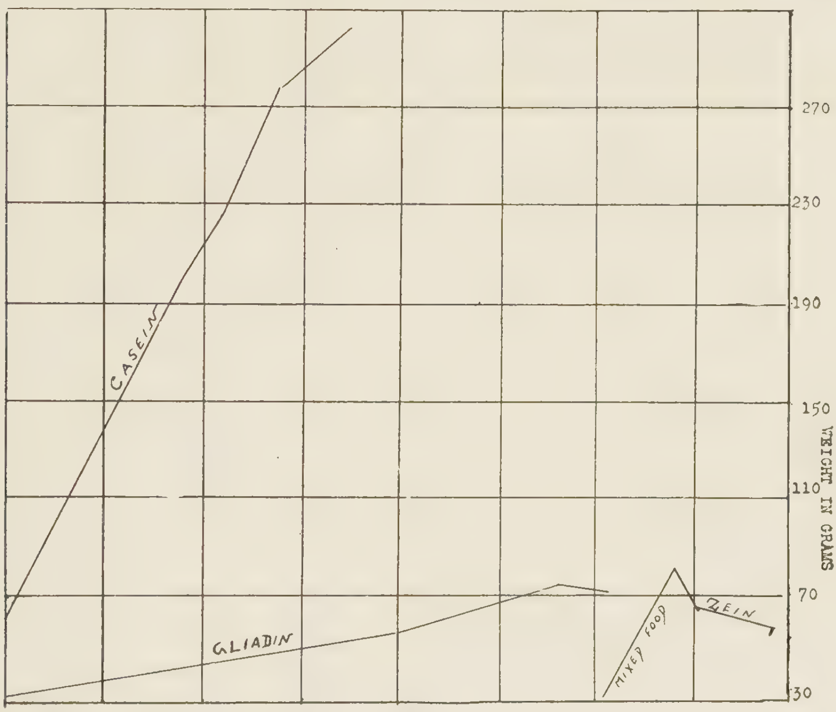



Fig. 25.—Showing typical curves of growth of rats on diets otherwise similar and adequate but containing in each case a single protein—casein, gliadin or zein.

on the other hand must always be present even to maintain weight; the animal body is not able to make tryptophane, or only in insufficient quantities and the proteins of the food must always supply it. *Lysine* is necessary in the period of growth but apparently need not be present in the diet of a full grown animal to maintain strength and weight. *Cystine* apparently also must be present in the growth period, although slow growth can go on with very small quantities.

Taking some familiar proteins of all diets, Osborne and Mendel showed that egg albumen, which contains no glycine, added, as the sole protein,

to a diet adequate in all other factors, will maintain normal nutrition, and young animals will grow at normal rates upon such a diet. Lactalbumin, the simple albumin of milk, has the same property even more strikingly than egg albumen. Glutenin of wheat and also maize glutelin when used as the sole protein of diet are capable of maintaining nutrition and growth. On the other hand gliadin, also a protein of wheat flour, differing from glutenin in solubility and in cleavage products, will maintain grown rats but will not support growth. Glutenin and gliadin together constitute the gluten of wheat flour. Zein, a protein of corn, fed alone, failed both to maintain weight and to promote growth.

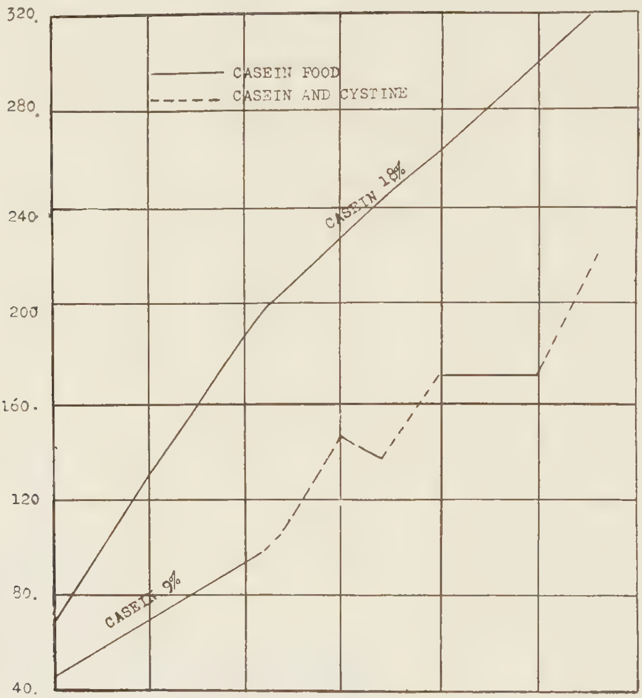



Fig. 26.—Showing that the deficiency of a low casein diet was essentially due to its relative deficiency in cystine.

The reason for these results, Osborne and Mendel see in the varied requisite amino-acid content of the various proteins. Zein contains no tryptophane; tryptophane is necessary, as has been said above, both for nutrition and growth. Gliadin will not promote growth largely because of its low lysine content. By adding pure tryptophane to zein, and lysine to gliadin the combination was found adequate. The charts of some of these actual experiments should be studied. (N.B.—These experiments have nothing to do with the question of vitamine content of food.)

However, the conditions of these experiments have nothing to do with normal conditions of diet either for animals or man. They were done with a single isolated protein, whereas in the normal diet there are always numerous proteins. But by these experiments Osborne and Mendel have shown most graphically the manner in which proteins supplement each other in nutrition. The average diet containing both vegetable and animal proteins will supply all the necessary elements, i.e., will contain "complete" proteins, and the animal organism will select them in proper proportions.

4. **Water.**—All food substances contain water. Some vegetables contain as high as 90 per cent. Milk contains 87 per cent water, eggs 65 per cent. Animal flesh contains 50 per cent water.

5. **Inorganic Minerals.**—The diet must contain suitable salts of the following elements—calcium, magnesium, sodium, potassium, iron, chlorine, iodine, phosphorus and sulphur. These salts in metabolism, are used both in structure and in energy exchange. For instance calcium is needed in the composition of bone; sodium chloride, potassium, iron, etc., in the composition of blood and blood serum; iodine in the thyroid gland.

6. **Vitamines.**—During all the early work on the metabolism of foods, and indeed up to 1911, it was assumed that a diet which contained a sufficient fuel value, (in the form of fats and carbohydrates), protein content, inorganic mineral content and water content was adequate for all conditions of nutrition. In 1911, however, Funk announced that there was a substance belonging to none of these categories to which he gave the name of vitamine, which was essential to health. The problem of beri-beri was one which had long attracted attention. This disease is a form of neuritis, particularly likely to occur in the Orient—Japan, China, and Philippines, etc. It was considered usually as an infection, and was so classified for instance in the earlier editions of such a book as Osler's, "Practice of Medicine." Takaki, an inspector general in the Japanese navy, was impressed with the large number of cases occurring among sailors, and began an investigation of it. He concluded that it was not due to sanitary conditions; the ships of the Japanese navy were as clean and living conditions as sanitary as those aboard ships of other navies in which beri-beri was not prevalent. In like manner he eliminated the question of climate and infection. He then concentrated on the food problem. The Japanese sailor, like other inhabitants of the Far East, lives largely on a diet of rice; and this is usually prepared by a process of polishing or milling, which removes the outer shell or pericarp. Takaki sent out two vessels over the same route, on one of which the ordinary diet was allowed, but on the other the rice

was decreased, and barley, meat, vegetables and condensed milk added. On the ship with the rice diet there were in nine months 169 cases and 25 deaths from beri-beri. On the other ship there were only 14 cases, and in each case the man had failed to eat his full allowance of the new foods.

This work was not given sufficient notice at the time. Takaki considered that the improvement was due to the addition of protein to the diet. In 1907, however, Braddon emphasized the probability that the disease was due to the removal from the rice of some substance contained in the pericarp, that is, it occurred only in those eating "polished" rice. This was confirmed by numerous dietetic experiments notably those of Chamberlain with the Philippine Scouts in 1909.

What this antineuritic substance was, became the subject of several experiments. It had been shown by Eijkmann that it is possible to produce a polyneuritis in fowls by feeding them on a diet of polished rice for three or four weeks. This gave an experimental animal to work with.

Schumann and Aron considered the disease to be due to the low phosphorus content of beri-beri foods, but this was disproved by Fraser and Stanton who showed that rice polishings which contained only 15 per cent of their phosphorus were capable of preventing beri-beri. Chamberlain tried the addition of various inorganic salts—sugar, lecithin, etc., all without effect. It was found, however, that if polished rice were given to fowls, and the rice polishings or rice bran were added to the diet the birds did not develop neuritis. Working with this rice bran, Chamberlain and his associates found that the antineuritic substance is soluble in water and alcohol, insoluble in ether, and was destroyed by heating and alkalies. Fresh meat, milk and potatoes were also found to have antineuritic properties.

Funk deserves priority for isolating a definite chemical substance, prepared from rice bran and yeast. Pigeons suffering from neuritis were able to run and fly within a few hours of the administration of 2 to 8 milligrams of this substance. Its chemical nature has not been definitely determined, but it appears to be an organic nitrogenous base related to the pyrimidines. It is now generally called *water-soluble B vitamine*. In human beri-beri it has been used with therapeutic success.

This work stimulated the study of other diesases which appear upon *a priori* grounds to be diet-deficiency diseases. *Infantile scurvy* is known to be curable by feeding orange juice or potato and whole milk, and is probably due to faulty feeding, particularly with condensed milk or stale pasteurized milk. *Adult scurvy* is a disease which develops under conditions where there is a long privation from fresh food. It

was more prevalent formerly than now, and occurred in sailors who were on long voyages and many months at sea. It can be cured by the administration of fresh foods, particularly fruits, such as lemons and limes, and fresh vegetables, particularly potatoes. *Rickets* seems to respond to the administration of fats, as in cod-liver oil, along with other treatment, and there is sufficient in the etiology of rickets to make it suggestive as a disease partly due to vitamine-deficiency. *Pellagra* is another disease apparently of similar character. It has developed in the southern states, and occurs particularly in that part of the population that eats maize, tubers, seed products, molasses and fat meat. It is in the spring after a winter of such a diet that the symptoms of the disease recur, while during the summer when green vegetables are eaten, partial or complete recovery takes place.

It is proper to state that only in beri-beri has it been generally acknowledged that a definite vitamine is responsible, by its absence, for the disease. It is very probable that infantile scurvy is due to the lack of a vitamine found in fruit juice and potato and called water-soluble C vitamine, but this is disputed by able physiologists.

The vitamines also seem to be necessary to favorable growth. When Osborne and Mendel were conducting their experiments on the relation of food to growth, they found that combinations of isolated food substances were often insufficient, but when protein-free milk was added

Table VII

Table of Vitamines

| NAME | WHERE FOUND | DEFICIENCY CAUSES |
|---|---|---|
| Fat-Soluble A | Milk fat—cream, butter<br>Yolk of egg.<br>Fish oils—cod-liver oil | Impaired growth<br>Rickets ?<br>Xerophthalmia<br>Pellagra ?? |
| Water-Soluble B | Yeast<br>Rice and wheat bran<br>Milk | Impaired growth<br>Beri-beri<br>Polyneuritis in birds |
| Water-Soluble C | Orange juice<br>Potato<br>Milk<br>Lemon and lime juice<br>Green vegetables | Infantile scurvy ?<br>Scurvy ?<br>Scorbutus ? |
| Vitamine D. | Cod-liver Oil<br>Fish oils<br>Butter fat<br>Coconut oil | Rickets |
| Vitamine E | Lettuce leaves<br>Cereals<br>Fresh meats.<br>Egg yolk. | Failure of reproductive functions. Animals without it develop and can conceive, but pregnancy terminates and the fetus and placenta are absorbed before delivery. |

growth was stimulated. McCallom and Davis found that both fat-soluble A vitamine and water-soluble B vitamine were necessary for normal growth.

### C. Caloric Requirements of the Human Body

The caloric values of three constituents of food, and the caloric requirements of the human body have been determined beyond any question by numerous careful experimenters, and are an integral part of medical science. The results of this work may be put down as follows:

Energy value of foods is measured in units called calories. The calorie used in dietetic nomenclature is the greater calorie or kilogram calorie. A calorie is the amount of heat required to raise the temperature of one kilogram of water one degree Centigrade (or of 1 pound eight degrees Fahrenheit).

| | | |
|---|---|---|
| 1 gram carbohydrate yields | 4.1 | calories |
| 1 gram fat yields | 9.45 | " |
| 1 gram protein yields | 4.35 | " |

These are conveniently remembered at carbohydrates 4, proteins 4, and fats 9, and these are the approximate physiologic fuel values because of carbohydrates after digestion 2 per cent is lost and 98 per cent absorbed, of fats 5 per cent is lost, and of proteins 8 per cent is lost.

The caloric requirements of a man vary with three factors—weight, height, amount of muscular work being done, and age.

TABLE VIII

| CALORIC REQUIREMENTS PER DAY: | CALORIES PER KILO | CALORIES PER POUND | MAN OF AVERAGE WT. 70 KILO – 150 LB. |
|---|---|---|---|
| In bed sleeping or resting | 24 | 11 | 1680 |
| Sitting, at rest | 34 | 15 | 2400 |
| Moderate work or exercise | 43 | 20 | 3000 |
| Heavy work—(lumberman, football player) | 85 | 38 | 6000 |

CALORIC REQUIREMENTS AT REST AT DIFFERENT AGES

| AGE | PER KILO | PER POUND |
|---|---|---|
| 1 | 100 | 44 |
| 5 | 82 | 37 |
| 10 | 70 | 31 |
| 20 | 46 | 21 |
| 30 | 40 | 18 |
| 40 | 36 | 16 |
| 80 | 27 | 11 |

So much for the calculated results. It is important to remember that under normal conditions of health, we have in appetite a very delicate regulator of the requirements of the body. During illness, particularly

fevers, this indicator may not allow us enough; as age advances it is inclined perhaps to deceive us into a belief that we need more than we do, but upon the whole it is a very safe guide.

**Calculation of Caloric Requirements.**—In the table of foods given on pages 267 to 273 it will be seen that in the last column is put down the caloric value per gram of the article. It is easy to calculate the caloric values of food from this, but for rapid informal calculation, the practitioner should be able to give a rough estimate of the caloric content of the average dish on his patient's table. In doing so it is convenient to remember that average helpings or servings of food, on American tables represent in a large number of cases, 100 calories. For instance a glass of milk, a thick slice of bread, one and a half lumps of sugar, one

Table IX

Table of Food Values in Units of 100 Calories

| | PROTEIN IN GM. |
|---|---|
| Milk (5 oz.) | 5. |
| Cream, 16 per cent (2 oz.) | 1.5 |
| Buttermilk, one ½ glasses (9.5 oz.) | 8. |
| Koumis, 1 glass (7 oz.) | 5. |
| Whey, 2 glasses (13 oz.) | 3.5 |
| Eggs, one ½ | 10. |
| Whites of eggs 6, | 24. |
| Yolks of eggs 2, | 4.5 |
| Oatmeal one ½ serving, (5.5 oz.) | 4.25 |
| Boiled rice, ordinary cereal dish (3 oz.) | 2.5 |
| Hominy, large serving (4.2 oz.) | 2.5 |
| White bread, home-made, 1 thick slice (1.25 oz.) | 3.2 |
| One small Vienna roll (1.2 oz.) | 3.2 |
| Butter, 1 pat, (1.5 oz.) | 0.0 |
| Sugar 3 teasps. one ½ lumps (0.8 oz.) | 0.0 |
| Oil, ⅓ oz. | 0.0 |
| Codfish, 2 servings (5 oz.) | 23. |
| Halibut steaks, 1 serving (2.8 oz.) | 15. |
| Mackerel, Spanish, 1 serving (2 oz.) | 12.2 |
| Shad, 1 serving (2.1 oz.) | 11.2 |
| Salmon, small serving (1.5 oz.) | 7.3 |
| Oysters 12 | 12. |
| Roast beef, ordinary serving (1.8 oz.) | 10. |
| Small sirloin steak (1.4 oz.) | 7.5 |
| Leg of lamb, or mutton, ord. serving (1.8 oz.) | 10. |
| Lamb chop, 1 small (1 oz.) | 6. |
| Bacon, small serv. medium fat, (0.5 oz.) | 1.5 |
| Chicken, broiler, edible portion, large serv. (3.2 oz.) | 19. |
| Turkey large serv. (1.2 oz.) | 7. |
| Potato, baked, 1 good size (3 oz.) | 3.75 |
| Potato, sweet, baked, ½ average potato (1.7 oz.) | 1.5 |
| String beans, 5 servings (16.66 oz.) | 3.75 |
| Spinach, 2 ordinary servings (6.1 oz.) | 3.7 |
| Peas, green, 1 serving (3 oz.) | 5.7 |
| American or Swiss cheese, 1.5 cubic in. (0.75 oz.) | 6. |
| One baked apple, (3.3 oz.) | 0.5 |

baked potato, an ordinary serving of meat, one and a half eggs—all represent roughly about 100 calories. To make this plainer a table is subjoined giving some common food values in units of 100 calories (Table IX).

### D. Protein Requirements of the Human Body

"Animal cells, under all conditions of life are constantly breaking down proteins into simpler substances which the body eliminates. Since this breaking down or 'catabolism' of protein does not stop either in fasting or under the most liberal feeding with fats and carbohydrates it follows that there is always a need for protein whatever the supply of other food." (Sherman.)

Aside, then, from the total caloric requirement of the body, there is a daily protein requirement. But to determine this is one of the most complicated problems in the science of nutrition. We can only briefly indicate some of the factors in the problem here.

**Nitrogenous or Protein Balance.**—The estimation of the total excretion of nitrogen from the body is taken to represent the amount of protein catabolism. Comparing this to the nitrogen content of the protein in the ingested food, we say that when the intake exceeds the output there is a storage of protein going on; when the output exceeds the intake there is a loss of body protein. When the intake equals the output the body is in nitrogenous or protein equilibrium.

Many factors influence this balance. The body will adjust itself to high or low levels of protein metabolism depending upon how much is in the diet. What the minimum requirement is has been hard to fix. It, of course, depends to a certain extent upon weight, and yet *proportionately,* the growing infant and the full grown man have about the same protein requirements—that is, it constitutes about 10 per cent of the total calories. Muscular work should theoretically be a factor, and yet muscles do not break down under exercise; they grow, and there is certainly a protein storage at this time.

A most important factor is the amount of the other food elements—carbohydrates and fats—in the diet. Under conditions of fasting, protein still continues to be eliminated. Succi, the professional faster, after fasting for 30 days was still excreting 33 grams of protein every day, and this was about the same as the amount he had excreted when he had been fasting 15 days. He felt well during the fast, and it might be supposed that the figure 33 grams represents the minimum requirement. But when more protein is administered to the body, nitrogenous balance is rapidly developed at the higher level, so that we must con-

sider simply that in the case of the faster the body adjusted itself to extremely low protein metabolism and that the low standard would be unsafe over a long period of time.

Tallquist performed some crucial experiments upon the question of the influence of carbohydrates and fats on the protein metabolism. Using himself as the subject he planned an experiment in which for eight days he received exactly the same amount of protein food, and the total amount of his food computed the same number of calories. During the first four days he had a large amount of carbohydrate (466 gm.) in the diet and a small amount (44 gm.) of fat. During the second four-day period he switched this around and had a large amount of fat (140 gm.) and a small amount of carbohydrate (250 gm.). He ate during the first four days meat, milk, butter, bread, sugar, coffee and beer; during the second four days he ate the same amounts of meat, milk, bread, coffee and beer, but he had less sugar, more butter and some bacon. The result of the experiment showed that during the period of high carbohydrate diet there was always a storage of protein, but as soon as the large amounts of carbohydrates were withdrawn, and the fats increased, the nitrogen balance fell so that more nitrogen was excreted than was ingested. Lusk experimenting upon himself found that when he was in nitrogenous equilibrium, the withdrawal of 250 grams of carbohydrate from the diet, caused, on the second day, a great increase in the nitrogen elimination.

This and other experimental evidence indicates that *carbohydrates are the sparers and protectors of the body protein.* This is a most important fact in connection with fever diets, and scanty diets for invalids, e.g., following surgical operations when soft food is necessary over a long time.

Summarizing the data, then, we find that protein is always eliminated even in fasting, that the amount of protein eliminated depends not so much upon the human being's age and activity, as upon the amount of protein he has been accustomed to in his diet, e.g., to the nitrogen balance which has been established, and to the amount of fats and carbohydrates in the diet.

Is it possible to determine the minimum amount of protein required per day? The amounts given by various physiologists have varied considerably. Voit gave the figure of 118 grams of protein per day; Rubner gave 127 grams, and Atwater 125 grams. The lowest figures given are those of Chittenden, and his results are sufficiently interesting to merit detailed review. For his work Chittenden chose first a group of laboratory workers, going about their work, then a squad of soldiers, at

light gymnastic work and light duty, and lastly a group of university athletes, at hard physical exercise. The plan was to lower the protein content very gradually, watching the weight and nitrogenous balance, until the lowest point of nitrogenous balance was reached. The result of the experiments indicated that the physiologic needs of the body are fully met by a metabolism of protein matter equal to an exchange of 0.10 to 0.12 gram of nitrogen per kilogram of body weight per day, provided a sufficient amount of nonnitrogenous foods is taken to meet the energy requirements of the body. For a man of 150 pounds, or 70 kilograms, about 60 grams of protein or a little less than two ounces a day is amply sufficient. It is well to emphasize that during the experiments, the subjects felt no discomfort, in fact expressed themselves as feeling better than when on a high protein diet, and that their efficiency did not seem to be impaired, that one subject of the university athletic group won an all-round gymnastic championship while on the diet.

Few persons, of course, would be content to remain on so low a protein intake. In reaching such a level nearly every one lost weight. The proteins are the great activators of metabolism, they speed up oxidation. For this reason meat is more desirable in winter than in summer, to help the body keep warm. But it should be remembered that, if necessary, Chittenden's figures are probably correct, and the actual protein requirement is somewhat close to 60 grams a day.

### E. Inorganic Mineral Metabolism

**Sodium Chloride.**—The amount of sodium chloride, table salt, in the average dietary constitutes the greater portion consumed; compared to it, the quantity present in food is negligible. In the body sodium chloride is required very largely in all tissues, particularly blood serum, and is also necessary, functionally, to maintain normal osmotic pressure and the retention of water in the tissues. To decrease the salt in the diet is to decrease the quantity in the tissues and hence to decrease their water content. The question of the daily requirement of the body for salt is somewhat complex. When none is taken the amount excreted in the urine falls rapidly on successive days. Goddall and Joslin placed a healthy man upon a diet adequate in protein and energy value but practically free from sodium chloride. The excretion of chlorine on successive days was: 4.6 gm. the first day, 2.52 gm. the second, 1.88 gm. the third, 0.87 gm. the fourth, until on the twelfth and thirteenth days he excreted 0.17 gm. each. Benedict's subject on prolonged fasting lost the equivalent of 13.93 grams of sodium chloride during the

first ten days, and about 20 gm. altogether during the thirty days of the fast. Since the body contains about 100 grams of sodium chloride, the total loss did not exceed one-fifth of the total amount.

It is possible that we eat too much salt, under average conditions of American life. Bunge believed that the craving for salt is due to the amount of vegetables in our diet. Carnivorous animals do not require salt, as they get it in the blood of their victims. Herbivores, as is well known, require to be supplied with it artificially. Bunge thought that the high intake of potassium in vegetable foods tends to increase sodium elimination. He experimented upon himself, taking 18 grams of potash per day, and found that this increased the elimination of sodium by 6 grams. He concluded that while we might be able to live without the use of salt as a condiment even on a diet largely vegetarian, we would have a strong disinclination to eat some foods such as potatoes with a high potassium content. "The use of salt enables us to employ a greater variety of the earth's products, than we could do without it. But we are accustomed to take far too much salt with our viands. Salt is not only an aliment, but a condiment, and easily lends itself, as all such things do, to abuse."

**Calcium.**—There is more calcium by weight in the human body, than any other of the inorganic elements—2 per cent—most of it in the bones. The calcium requirement of the body varies at different periods of life, it being largest in stages of growth and bone formation. The calcium requirement rises in women during pregnancy and lactation—as in the first condition she must furnish the fetus with bone building material, and in the second, she must supply the high calcium content of milk. Insufficient calcium in the diet during these periods may result in the body attacking the storage places of calcium and the weakening of teeth and bones at these periods results.

But even in periods of growth-equilibrium the body requires some calcium in the diet. The classical experiment of Voit may be cited. He kept a pigeon for a year on calcium-poor food. The bird showed no symptoms attributable to the diet until it was killed, when it was found that the sternum and skull were perforated at several places, due to the absorption of calcium salts. The bones concerned in locomotion were sound and showed no decrease in calcium, showing that the absorption has a selective action in the order in which the bones are attacked. Carefully performed metabolism experiments show that the average output of calcium is about 0.45 gram per day of a man of average body weight on a low calcium diet. The average intake of calcium on an average American dietary is from 50 to 100 per cent above the minimum needs.

TABLE X

APPROXIMATE AMOUNTS OF CALCIUM IN FOOD MATERIALS

| FOOD | CALCIUM PER 100 GRAMS EDIBLE SUBSTANCE | CALCIUM PER 100 GRAMS PROTEIN | CALCIUM PER 3000 CALORIES |
|---|---|---|---|
| | gm. | gm. | gm. |
| Beef, all lean | 0.007 | 0.03 | 0.18 |
| Eggs | 0.067 | 0.5 | 1.35 |
| Egg Yolk | 0.137 | 0.9 | 1.1 |
| Milk | 0.120 | 3.7 | 5.2 |
| Cheese | 0.931 | 3.5 | 6.4 |
| Wheat, entire grain | 0.045 | 0.33 | 0.40 |
| White flour | 0.020 | 0.18 | 0.18 |
| Rice, polished | 0.009 | 0.06 | 0.04 |
| Oatmeal | 0.069 | 0.4 | 0.5 |
| Beans, dried | 0.160 | 0.7 | 1.4 |
| Beets | 0.029 | 1.9 | 1.9 |
| Cabbage | 0.045 | 2.8 | 4.3 |
| Carrots | 0.056 | 5.1 | 3.7 |
| Potatoes | 0.014 | 0.6 | 0.5 |
| Turnips | 0.064 | 5.0 | 4.8 |
| Apples | 0.007 | 1.9 | 0.36 |
| Bananas | 0.009 | 0.7 | 0.27 |
| Oranges | 0.045 | 5.7 | 2.6 |
| Prunes, dried | 0.054 | 2.6 | 0.5 |
| Almonds | 0.239 | 1.2 | 1.1 |

**Sulphur.**—Sulphur metabolism is closely bound to protein metabolism, as most of the sulphur entering the body occurs in organic combination with protein. Thus legumin contains 0.38 per cent sulphur, zein 0.6 per cent, gliadin 1.2 per cent, and egg albumen 1.6 per cent. In the body the sulphur is converted largely into sulphuric acid and is neutralized as rapidly as formed and excreted as urinary sulphates. It is a necessary part of the muscle protein molecule.

**Phosphorus.**—Phosphorus is widely distributed in the animal body. It is part of cell nuclei, and is present in the skeleton, milk, sexual elements and the nervous system. It is a very important element in animal physiology, in the control of enzyme actions, the maintenance of neutrality in the organism, the conduction of nerve stimuli, etc. Phosphates are constantly excreted from the body even after long fasting.

Phosphorus occurs in food and in the animal body in three forms:

1. Inorganic Phosphates.—In the skeleton calcium phosphate is the chief inorganic constituent of bone. Potassium phosphate is the most abundant inorganic phosphate in food, and occurs in the blood serum and soft parts in considerable quantities, being an important factor in maintaining the neutrality of the body.

2. Phosphorus-containing proteins, particularly nucleo-proteins, lecitho-proteins, and the phosphato-proteins of casein of milk and ovovitellin of egg yolk.

3. Phosphatids—or phosphorus-containing fats, such as lecithin, cephalin, etc. They occur very largely in brain and nervous tissue. In foods, egg yolk contains large amounts.

4. It is possible that certain carbohydrate foods contain small amounts of phosphorus in the form of phytins, or the calcium magnesium and potassium salts of phytic acid, occurring in wheat kernels, grains, and legumes.

The metabolism of phosphorus has been the subject of a great deal of experimentation, and the results, while not entirely conclusive, are most important. The question of whether the body can best use phosphorus in the form of organic phosphorus compounds has engaged the attention of physiologists for many years. Rohmann believed that the phosphorus-containing proteins were much better adapted for furnishing material for tissue growth than simple proteins plus inorganic phosphates. A contrary view was held by Keller studying the phosphorus metabolism of young children: he found that the storage of phosphorus was favored by milk which contains inorganic phosphates in large amounts as well as organic phosphorus. Hart, McCollum and Fuller experimented on young pigs, first placing them on a diet too low in phosphorus to maintain normal growth; they found that by adding either a phosphate salt or by feeding foods containing phosphorus in

Table XI

Approximate Amounts of Phosphorus in Food Materials

| Food | Phosphorus per 100 grams edible substance | Phosphorus per 100 grams protein | Phosphorus per 3000 calories |
|---|---|---|---|
| Beef, all lean | 0.218 | 0.96 | 5.2 |
| Eggs | .180 | 1.35 | 3.66 |
| Egg yolk | .524 | 2.73 | 3.54 |
| Milk | .093 | 2.82 | 4.02 |
| Cheese | .683 | 2.58 | 4.68 |
| Wheat, entire grain | .423 | 3.25 | 3.54 |
| White flour | .092 | .81 | .78 |
| Rice, polished | .096 | 1.19 | .81 |
| Oatmeal | .392 | 2.36 | 2.97 |
| Beans, dried | .471 | 2.20 | 4.11 |
| Beets | .039 | 2.42 | 2.52 |
| Carrots | .046 | 4.17 | 3.03 |
| Potatoes | .058 | 2.60 | 2.07 |
| Turnips | .046 | 3.55 | 3.51 |
| Apples | .012 | 3.15 | 0.60 |
| Bananas | .031 | 2.35 | 0.93 |
| Oranges | .021 | 2.58 | 1.20 |
| Prunes, dried | .105 | 5.00 | 1.05 |
| Almonds | .465 | 2.25 | 2.16 |
| Peanuts | .399 | 1.55 | 2.19 |
| Walnuts | .357 | 1.96 | 1.53 |

organic combination they immediately regained their lost weight. McCollum experimented on young growing rats; they were fed on a diet free from phosphorus and the phosphorus was added only in inorganic form as phosphates: at the end of 127 days one of the rats had doubled in weight; he was killed and his tissues analyzed were found of normal composition. This animal must have built up his nucleo-proteins and other tissues containing phosphorus from inorganic phosphorus. From these experiments it seems evident that animals can maintain phosphorus equilibrium on either inorganic or organic phosphorus alone, but it is probable that a combination of these elements in the food is desirable for favorable nutritive conditions.

The phosphorus requirement of the body has been determined within reasonable limits. Balance experiments upon men and women both have shown an average of 0.96 gram of phosphorus a day per 70 kilograms body weight. This is a minimum. We may say that the safe average requirement for man is 1.44 grams a day.

The amount of phosphorus in various foods may be seen from Table XI.

Sherman is of the opinion that the average American dietary is closer to the lowest phosphorus requirement than is always safe, and suggests that perhaps some cases of malnutrition are due to insufficiency of phosphorus. This may account for the value of the hypophosphites as "tonics" in some cases. At any rate the deficiency if it exists should be made up by attention to the diet.

**Iron.**—It is estimated that there is 0.004 per cent of iron in the body, or about 3 grams at the average weight. The largest part of it is as a constituent of hemoglobin and its presence is of the highest importance. There is no iron reserve in the body, as there is a calcium reserve in the bones, so that the entire source of iron is from the food.

The iron requirement of the body has not been agreed upon with exactness. Various observers have found variations from 6 to 16 milligrams per day. For want of better figures we must take this as the minimum and maximum amounts. The animal organism probably loses little of its iron per day, under normal conditions, that is, without hemorrhage. Women, on account of the menstrual loss and during pregnancy and lactation, have a higher requirement than men.

A long controversy has raged as to whether the body can assimilate iron in inorganic form. Bunge held that inorganic iron, used in anemias, was not utilized as such but allowed of a larger absorption of organic iron in the food, by absorbing the sulphur in the intestine, liberated as sulphide through intestinal putrefaction. His conclusions, however, were vitiated when Stockman showed in carefully conducted experiments in chlorosis, that iron, given hypodermically, will cure the

disease. Stockman also gave iron sulphide by mouth in chlorosis and reported cures with it: these must have resulted from the absorption of inorganic iron because ferrous sulphide cannot take up any more sulphur. Many contributions to the controversy have been made, too extended to quote, but the result seems to be that under normal conditions the body always does and prefers to utilize organic iron compounds although it undoubtedly can utilize inorganic iron.

*Iron in Food.*—The amount of iron in certain foods may be seen in Table XII.

TABLE XII

IRON IN TYPICAL FOOD MATERIALS

| FOOD | IRON PER 100 GRAMS FRESH SUBSTANCE MILLIGRAMS | IRON PER 100 GRAMS PROTEIN MILLIGRAMS | IRON PER 3000 CALORIES MILLIGRAMS |
|---|---|---|---|
| Beef, all lean | 3.85 | 16 | 97 |
| Beefsteak, medium fat | 2.2 | 16 | 47 |
| Eggs | 3.0 | 22 | 57 |
| Egg yolk | 8.6 | 53 | 69 |
| Milk, whole | 0.24 | 7 | 10 |
| Milk, skimmed | 0.25 | 7 | 20 |
| Cheese | 1.3 | 5 | 9 |
| Oatmeal | 3.8 | 22 | 26 |
| Rice, polished | 0.9 | 11 | 7 |
| White flour | 1.0 | 7 | 7 |
| Wheat, entire grain | 5.0 | 37 | 42 |
| Beans, dried | 7.0 | 40 | 60 |
| Beans, string, fresh | 1.1 | 48 | 80 |
| Beets | 0.6 | 38 | 39 |
| Cabbage | 1.1 | 69 | 104 |
| Carrots | 0.6 | 55 | 40 |
| Corn, sweet | 0.8 | 26 | 23 |
| Peas, dried | 5.7 | 23 | 46 |
| Potatoes | 1.3 | 55 | 42 |
| Spinach | 3.6 | 135 | 450 |
| Turnips | 0.5 | 39 | 38 |
| Apples | 0.3 | 78 | 15 |
| Bananas | 0.6 | 47 | 18 |
| Oranges | 0.2 | 25 | 12 |
| Prunes, dried | 3.0 | 143 | 30 |
| Almonds | 3.9 | 19 | 18 |
| Peanuts | 2.0 | 8 | 11 |
| Walnuts | 2.1 | 11 | 9 |

## F. Fate of Food Principles in the Body

**Carbohydrates.**—The more complex carbohydrates are broken down into monosaccharides by the starch-splitting enzymes, the ptyalin of the saliva, the amylopsin of the pancreatic secretion, the invertase, maltose and lactose of the intestinal juice. The simpler sugars then, largely in the form of glucose, are absorbed by the capillary vessels of the intestinal wall and carried to the liver, by way of the portal vein. After

a meal rich in carbohydrate the blood in the portal vein may have twice as much glucose as under normal circumstances. Levulose and galactose may also be present. The amount of glucose in the circulating blood, however, remains pretty constant at a figure of about 0.1 per cent, varying only slightly in normal persons even after feeding large amounts of starches and sugars. We must infer then that the glucose is stored largely in the liver and given off to meet the needs of the body for energy demand. It is stored in the form of glycogen or animal starch. The muscles also store glycogen.

The glycogen stored in the liver is reconverted into glucose before it passes into the blood stream. Glucose is burned in the muscles. Comparison of arterial blood going into a muscle, with venous blood coming out, shows that the venous blood is poorer in glucose and oxygen and richer in carbon dioxide. The more active the muscle the more striking is this change, thus showing that the rapidity of the oxidation of the glucose is dependent upon the amount of muscular work done.

The chemical changes which occur in the muscle during the burning of glucose, are a matter which is still largely conjectural. The glucose molecule is certainly not burned directly to carbon dioxide and water. It probably undergoes cleavage into three carbon compounds, or glyceric aldehyde (the reaction being $\underset{\text{glucose}}{C_2H_{12}O_6} = \underset{\text{glyceric aldehyde}}{2CH_2OH - CHOH.\ CHO}$).

Some lactic acid is also formed. However, this intermediate carbohydrate metabolism is not of major practical importance: the interested are referred to Woodyatt's Harvey lecture of 1915 on that subject.

The practical point is that the primary function of carbohydrate is to supply energy. When the supply of carbohydrate in the food is more abundant than the body needs, it tends to be stored no longer as glycogen in liver and muscle, but as fat. It scarcely needs any experimental evidence to prove that this is so, although there is plenty of it. For instance a cow kept for fifty-nine days upon food from which nearly all the fat had been removed, still produced twice as much milk fat as could be accounted for by the fat and protein of the food, and in the meantime the cow gained in weight. Pigs of one litter and one size were used by Lawes and Gilbert; they killed some and analyzed them as controls. The rest were fed known amounts of food substances; when later killed and analyzed the bodies showed that the amounts of fat stored were much larger than could be calculated from the fat and protein intake.

The chemical changes involved in the transformation of carbohydrate into fat are entirely conjectural, and, even so, quite obscure.

**Fats.**—Fats are split up largely by the lipase of the pancreatic juice into glycerol and fatty acids. Probably during absorption through the intestinal wall they are reconverted into neutral fat. Fat is taken up by the lymph vessels, rather than the capillaries, and enters the blood stream with the lymph. Part of the fat is burned as fuel, probably in the muscles; this is probably accomplished by splitting the fat into glycerol and fatty acid again by the lipase that is found in many tissues in the body: the fat that lies in the storage tissue—subcutaneous tissue and peritoneum—does not undergo oxidation in these places.

The oxidation of the glycerol is probably very simply accomplished by converting it first to glyceric aldehyde, the substance formed in the first stage of the intermediate metabolism of carbohydrate from which point it probably follows the further steps of the carbohydrate metabolism.

The fatty acids break down slowly according to the beta-oxidation theory of Dakin and of Knoop. The knowledge of this is so important to the understanding of diabetes mellitus that it is given somewhat in full, in the words of Sherman:

"According to this theory the fatty acid is attacked by oxidation at the B-carbon atom with the probable formation of B-hydroxy, and then of B-ketonic acids. Further oxidation at this point must then cause a separation of the A- and B-carbon atoms; thus two carbons of the original fatty acid break away, presumably to undergo complete oxidation, and there remains a fatty acid with two less carbon atoms than the original. By such a process stearic acid would yield palmitic; palmitic would yield myristic; myristic, lauric; and so on to butyric acid. Beta-oxidation of butyric acid would yield successively B-oxybutyric, and acetoacetic acid. Normally the acetoacetic acid should yield two molecules of acetic, which in turn should burn to carbon dioxide and water.

"The sequence of changes from caproic acid to the final oxidation products would thus be as follows:

| Caproic acid | B-oxy (hydroxy) | B-keto caproic | Butyric | B-oxy butyric | Aceto-acetic | Acetic | Carbonic |
|---|---|---|---|---|---|---|---|
| $CH_3$ | $CH_3$ | $CH_3$ | $CH_3$ | $CH_3$ | $CH_3$ | $2CH_3$ | $4CO_2$ |
| $CH_2$ | $CH_2$ | $CH_2$ | $CH_2$ | CHOH | $CO_2$ | COOH | $+4H_2O$ |
| $CH_2$ | $CH_2$ | $CH_2$ | $CH_2$ | $CH_2$ | $CH_2$ | | |
| $CH_2$ | CHOH | CO | COOH | COOH | COOH | | |
| $CH_2$ | $CH_2$ | $CH_2$ | | | | | |
| COOH | COOH | COOH | | | | | |

"When the normal process is interfered with or overtaxed, another reaction may occur with the formation from acetoacetic acid of carbon dioxide and acetone, which later, like acetoacetic acid and B oxybutyric

acid, sometimes appears in the urine, especially in many cases of diabetes mellitus. The acidosis of diabetes is believed to be due to the B-oxy-butyric acid and acetoacetic acid thus formed."

Aside from its nutritive value, fat is stored as such in the body, and may also go to the catabolism of proteins. Whether carbohydrate is formed from fat is an unsettled question.

**Protein.**—Proteins, during digestion, are split up by various proteolytic enzymes of the stomach, pancreas and intestine, and completely converted into various amino-acids. These amino-acids are absorbed into the blood stream and are carried unchanged past the liver to the tissues of the body where they are absorbed by these tissues and to an extent concomitant with the needs of the particular tissue they are built up again into the complex protein molecule. The amino-acids not used in synthesizing protein are broken down again and either carried off to be excreted by the kidneys in the form of urea, etc., or are burned for fuel by the muscles.

Thus the body tissues are built up entirely from amino-acids. Indeed it has been shown that dogs could be kept in a normal condition of nutrition by furnishing proteins exclusively in the form of amino-acids intravenously. It is a point most important for the therapist of nephritis to note that Van Slyke showed that the amino-acids in the blood are present at all times, even during fasting, and that high protein feeding does not increase their concentration over a certain amount.

Besides this most important of its functions, the replacement of tissue waste, protein does furnish fuel to the body. Rubner coined the phrase "the specific dynamic action of protein"—by which he meant that the utilization of protein seemed to speed up all the metabolic processes of the body.

This utilization of protein is seen soon after a high-protein meal by the appearance of nitrogenous end-products in the urine—urea and uric acid, etc. All of the protein molecule, however, is not utilized in this way, and there is evidence to show that there is both a non-nitrogenous portion and a nitrogenous portion of the protein molecule metabolized under somewhat different conditions. Carbohydrates for instance can certainly be formed from proteins and burned. In severe cases of diabetes glucose is excreted even when there is no carbohydrate or fat whatsoever in the diet. Lusk showed that alanine, one of the cleavage products of protein, will yield glucose abundantly in the body. Aside from the production of carbohydrates, protein may also form fat, although this is not nearly so certainly established as the former.

## III. RELATION OF THE PHYSIOLOGY OF DIGESTION TO DIETETICS

A number of researches in modern physiology should be in the minds of physicians continuously when prescribing diets for a patient.

First are the experiments of Pawlow, on the flow of gastric juice as a result of sensory stimuli, e.g., the sight and smell of foods. We often hear patients say, "I like this or that article of food, and whenever I see it, I am tempted to eat it, but I suppose it isn't good for me." It will be remembered that Pawlow found that with dogs with gastric fistulæ the sight and even the smell of food which they wanted started a flow of gastric juice. The chewing of such food increased the flow, while the sight and smell of spoiled food, or unappetizing food dried up secretion. Fear, anger and pain will also cause a cessation of stomach secretion. These observations have been repeated in man. Hawk and Rehfuss found that young men with small stomach tubes inserted so that the flow of secretion could be measured at any time produced a copious flow of gastric juice at the smell of viands cooking, and at the sight of a plate of well cooked food, but that when a charred steak or poorly cooked food was brought in the secretory curve rapidly fell. These facts demonstrate that food which we relish will be the most easily digested. And, especially in neurotic patients, undernourished on account of their own phobias, what they want is best for them.

Second, it is important to know the varying rates at which different foodstuffs leave the stomach. The pylorus opens and closes, and food is allowed to pass into the duodenum in response to a very delicate mechanism. When the duodenal side of the pylorus is alkaline and the pyloric side is acid the pyloric sphincter will relax and allow a spurt of gastric contents to escape into the duodenum: this bolus of material, being fresh from the stomach is acid, and gives to the duodenum an acid reaction. When this occurs the pylorus once more closes tightly. Only when it has been neutralized by the alkaline intestinal chyme does it again relax and allow another spurt of gastric contents to enter the duodenum. The order in which foodstuffs leave the stomach is, first, water, then carbohydrates, proteins, fats and protein-fat combinations. Water probably does not stay in the stomach any appreciable time. Carbohydrates leave next most quickly. Fats remain longest, probably because they retard both gastric movement and gastric secretion. Fat and protein together take even longer, an explanation of the "indigestibility" of fried meats. Protein alone takes longer than carbohydrate, because protein combines with gastric acid and thus delays the appearance of free acid at the pylorus.

Third, the work of Cannon and Washburn and of Carlson have tended to emphasize the rôle of stomach movements in the sensations of appetite and hunger. Appetite may exist separately from hunger: it may result from pleasant sensory stimuli and have nothing to do with the fullness or emptiness of the stomach. Hunger on the other hand is a dull ache or gnawing sensation, and is the organism's first strong demand for nutriment. The sensations of hunger are due to successive muscular waves over the stomach wall: this has been shown both by Cannon and Washburn and by Carlson by having a subject swallow a rubber balloon attached to the end of a rubber tube and connected with a recording apparatus: when the sensation of hunger began the record always showed vigorous gastric movements. Sensations in the stomach in general are usually due to gastric movements, rather than secretion, to which latter they are largely attributed.

Fourth, the rate of passage of material through the gastrointestinal tract under normal conditions should be known. The stomach is nearly always empty six to eight hours after ingestion of any meal. Intestinal contents begin to appear at the ileocecal valve in about two hours.

Lastly, the variation in "digestibility" of various foods needs to be considered. This, however, is a topic which has not received a great deal of experimental attention. Most foods, even when they make the patient quite uncomfortable and are considered to be indigestible are digested and absorbed: witness the good nutrition of ulcer patients. The method of cooking has something to do with the digestibility of foods. Bateman, for instance, found that so well known a substance as egg white when fed raw is by no means well utilized. The practice of feeding egg white uncooked is so universal that Bateman's own words should be noted by all dietitians: "A substance which fails to stimulate a flow of gastric juice, and is antipeptic; which hurries from the stomach, calls forth no flow of bile, and strongly resists the action of trypsin, which is poorly utilized and may cause diarrhea, has evidently little to recommend it as a foodstuff for a sound person, let alone for an invalid. And when the native protein needs only to be coagulated at 70° in order to obviate almost all the effects mentioned, there appears still less reason for using it uncooked." There is an old tradition that white meat is more digestible than dark or red meat: it possesses a shorter, softer, and more tender fiber, and has a smaller content of extractives than the darker meats, and these factors probably account for the almost unanimous verdict of "dyspeptics" in its favor. Why fried foods cause discomfort cannot be stated upon any experimental basis: aside from the probability of their long residence in the stomach, it is probably because the fat and condiment present stimulate secretion, and the fatty envel-

ope of each particle of food prevents easy combination with the acid gastric juice. The experiments of Rehfuss and Hawk indicate that the temperatures of foods whether very hot or very cold are quickly reduced to the temperature of the stomach after being swallowed.

TABLE XIII

TABLE OF FOODS

| FOOD | | PROTEIN (N×6.25) PER CENT | FAT PER CENT | CARBO-HYDRATE PER CENT | FUEL VALUE PER POUND CALORIES | 100 CALORIE PORTION GRAMS |
|---|---|---|---|---|---|---|
| Almonds | E.P.* | 21.0 | 54.9 | 17.3 | 2940 | 15 |
| | A.P.* | 11.5 | 30.2 | 9.5 | 1615 | 28 |
| Apples | E.P. | .4 | .5 | 14.2 | 285 | 159 |
| | A.P. | .3 | .3 | 10.8 | 214 | 212 |
| Apricots | E.P. | 1.1 | .... | 13.4 | 263 | 174 |
| | A.P. | 1.0 | .... | 12.6 | 247 | 184 |
| Artichoke, French | E.P. | 3.4 | .5 | 12.0 | 300 | 151 |
| | A.P. | 1.7 | .3 | 6.0 | 150 | 302 |
| Asparagus, fresh | E.P. | 1.8 | .2 | 3.3 | 100 | 450 |
| cooked | A.P. | 2.1 | 3.3 | 2.2 | 213 | 213 |
| Avocado | E.P. | 2.1 | 20.1 | 7.4 | 993 | 46 |
| | A.P. | 1.4 | 13.2 | 4.8 | 652 | 70 |
| Bacon, smoked | E.P. | 10.5 | 64.8 | .... | 2840 | 16 |
| | A.P. | 9.5 | 59.4 | .... | 2372 | 19 |
| Bananas | E.P. | 1.3 | .6 | 22.0 | 447 | 101 |
| | A.P. | .8 | .4 | 14.3 | 290 | 156 |
| Barley, pearled | | 8.5 | 1.1 | 77.8 | 1615 | 28 |
| Beans, dried | | 22.5 | 1.8 | 59.6 | 1586 | 29 |
| Lima, dried | | 18.1 | 1.5 | 65.9 | 1586 | 29 |
| Lima, fresh | E.P. | 7.1 | .7 | 22.0 | 557 | 82 |
| | A.P. | 3.2 | .3 | 9.9 | 250 | 182 |
| Beans, string, fresh | E.P. | 2.3 | .3 | 7.4 | 184 | 241 |
| | A.P. | 2.1 | .3 | 6.9 | 176 | 259 |
| Baked, canned | A.P. | 6.9 | 2.5 | 19.6 | 583 | 78 |
| Red kidney, canned | | 7.0 | .2 | 18.5 | 471 | 96 |
| Beef, brisket medium fat | E.P. | 15.8 | 28.5 | .... | 1449 | 31 |
| | A.P. | 12.0 | 22.3 | .... | 1130 | 40 |
| chuck, average | E.P. | 19.2 | 15.4 | .... | 978 | 46 |
| | A.P. | 15.8 | 12.5 | .... | 797 | 58 |
| corned, average | E.P. | 15.6 | 26.2 | .... | 1353 | 34 |
| | A.P. | 14.3 | 23.8 | .... | 1230 | 37 |
| cross ribs, average | E.P. | 15.9 | 28.2 | .... | 1440 | 32 |
| | A.P. | 13.8 | 24.8 | .... | 1262 | 36 |
| dried, salted and smoked | E.P. | 30.0 | 6.5 | .4 | 817 | 56 |
| | A.P. | 26.4 | 6.9 | .... | 760 | 60 |
| flank, lean | E.P. | 20.8 | 11.3 | .... | 838 | 54 |
| | A.P. | 20.5 | 11.0 | .... | 821 | 55 |
| forequarter, lean | E.P. | 18.9 | 12.2 | .... | 842 | 54 |
| | A.P. | 14.7 | 9.5 | .... | 655 | 69 |
| fore shank, lean | E.P. | 22.0 | 6.1 | .... | 647 | 70 |
| | A.P. | 14.0 | 3.9 | .... | 414 | 110 |
| heart | E.P. | 16.0 | 20.4 | 1.0 | 1140 | 40 |
| | A.P. | 14.8 | 24.7 | .9 | 1292 | 35 |
| hindquarter, lean | E.P. | 20.0 | 13.4 | .... | 907 | 50 |
| | A.P. | 16.7 | 11.2 | .... | 757 | 60 |

*E. P. signifies edible portion; A. P. signifies as purchased.

TABLE XIII—CONT'D

| FOOD | | PROTEIN (N×6.25) PER CENT | FAT PER CENT | CARBO-HYDRATE PER CENT | FUEL VALUE PER POUND CALORIES | 100 CALORIE PORTION GRAMS |
|---|---|---|---|---|---|---|
| Beef, hind shank, lean | E.P* | 21.9 | 5.4 | .... | 617 | 75 |
| | A.P.* | 9.1 | 2.2 | .... | 255 | 179 |
| hind shank, fat | E.P. | 20.4 | 18.8 | .... | 1171 | 40 |
| | A.P. | 9.9 | 9.1 | .... | 552 | 83 |
| liver | E.P. | 20.4 | 4.5 | 1.7 | 584 | 78 |
| | A.P. | 20.2 | 3.1 | 2.5 | 537 | 85 |
| loin | E.P. | 19.7 | 12.7 | .... | 877 | 52 |
| | A.P. | 17.1 | 11.1 | .... | 764 | 60 |
| plate, lean | E.P. | 21.4 | 8.4 | .... | 732 | 62 |
| | A.P. | 15.1 | 5.9 | .... | 493 | 93 |
| neck, medium fat | E.P. | 20.1 | 16.5 | .... | 1040 | 44 |
| plate, lean | | | | | | |
| | A.P. | 14.5 | 11.9 | .... | 749 | 61 |
| | E.P. | 15.6 | 18.8 | .... | 1051 | 43 |
| | A.P. | 13.0 | 15.5 | .... | 867 | 52 |
| Porterhouse steak | E.P. | 21.9 | 20.4 | .... | 1230 | 37 |
| | A.P. | 19.1 | 17.9 | .... | 1077 | 42 |
| rib rolls, lean | A.P. | 20.2 | 10.5 | .... | 795 | 57 |
| ribs, lean | E.P. | 19.6 | 12.0 | .... | 845 | 54 |
| | A.P. | 15.2 | 9.3 | .... | 654 | 69 |
| ribs, fat | E.P. | 15.0 | 35.6 | .... | 1721 | 26 |
| | A.P. | 12.7 | 30.6 | .... | 1480 | 31 |
| round, lean | E.P. | 21.3 | 7.9 | .... | 709 | 64 |
| | A.P. | 19.5 | 7.3 | .... | 649 | 70 |
| round, free from visible fat | | 23.2 | 2.5 | .... | 512 | 87 |
| rump, lean | E.P. | 20.9 | 13.7 | .... | 940 | 49 |
| | A.P. | 19.1 | 11.0 | .... | 796 | 57 |
| rump, fat | E.P. | 16.8 | 35.7 | .... | 1763 | 26 |
| | A.P. | 12.9 | 27.6 | .... | 1361 | 33 |
| sides, lean | E.P. | 19.3 | 13.2 | .... | 890 | 51 |
| | A.P. | 15.5 | 10.6 | .... | 715 | 64 |
| sirloin steak | E.P. | 18.9 | 18.5 | .... | 1099 | 41 |
| | A.P. | 16.5 | 16.1 | .... | 960 | 48 |
| sweetbreads | A.P. | 16.8 | 12.1 | .... | 799 | 57 |
| tenderloin | A.P. | 16.2 | 24.4 | .... | 1290 | 35 |
| tongue | E.P. | 18.9 | 9.2 | .... | 717 | 63 |
| | A.P. | 14.1 | 6.7 | .... | 529 | 86 |
| Beets, cooked | E.P. | 2.3 | .1 | 7.4 | 180 | 252 |
| fresh | E.P. | 1.6 | .1 | 9.7 | 209 | 217 |
| | A.P. | 1.3 | .1 | 7.7 | 167 | 271 |
| Blackberries | A.P. | 1.3 | 1.0 | 10.9 | 262 | 173 |
| Blackfish | E.P. | 18.7 | 1.3 | .... | 393 | 116 |
| | A.P. | 7.4 | .7 | .... | 163 | 279 |
| Bluefish | E.P. | 19.4 | 1.2 | .... | 402 | 113 |
| | A.P. | 10.0 | .6 | .... | 206 | 220 |
| Boston crackers | | 11.0 | 8.5 | 71.1 | 1835 | 25 |
| Brazil nuts | E.P. | 17.0 | 66.8 | 7.0 | 3162 | 14 |
| | A.P. | 8.6 | 33.7 | 3.5 | 1591 | 28 |
| Bread, Boston brown | | 6.0 | 6.3 | 54.0 | 1345 | 34 |
| graham | | 8.9 | 1.8 | 52.1 | 1189 | 38 |
| rolls, water | | 9.0 | 3.0 | 54.2 | 1268 | 36 |
| toasted | | 11.5 | 1.6 | 61.2 | 1385 | 33 |
| white, homemade | | 9.1 | 1.6 | 53.3 | 1199 | 38 |
| milk | | 9.6 | 1.4 | 51.1 | 1158 | 39 |
| Vienna | | 9.4 | 1.2 | 54.1 | 1199 | 38 |

*E. P. signifies edible portion; A. P. signifies as purchased.

TABLE XIII—CONT'D

| FOOD | | PROTEIN (N×6.25) PER CENT | FAT PER CENT | CARBO-HYDRATE PER CENT | FUEL VALUE PER POUND CALORIES | 100 CALORIE PORTION GRAMS |
|---|---|---|---|---|---|---|
| Bread, average white | | 9.2 | 1.3 | 53.1 | 1182 | 38 |
| whole wheat | | 9.7 | .9 | 49.7 | 1113 | 41 |
| Buckwheat flour | | 6.4 | 1.2 | 77.9 | 1580 | 29 |
| Butter | | 1.0 | 85.0 | .... | 3491 | 13 |
| Buttermilk | | 3.0 | .5 | 4.8 | 162 | 280 |
| Butternuts | E.P.* | 27.9 | 61.2 | 3.5 | 3065 | 15 |
| | A.P.* | 3.8 | 8.3 | .5 | 417 | 109 |
| Cabbage | E.P. | 1.6 | .3 | 5.6 | 143 | 317 |
| | A.P. | 1.4 | .2 | 4.8 | 121 | 376 |
| Calf's foot jelly | | 4.3 | .... | 17.4 | 394 | 115 |
| Carrots, fresh | E.P. | 1.1 | .4 | 9.3 | 204 | 221 |
| | A.P. | .9 | .2 | 7.4 | 158 | 286 |
| Cauliflower | A.P. | 1.8 | .5 | 4.7 | 139 | 328 |
| Celery | E.P. | 1.1 | .1 | 3.3 | 84 | 542 |
| | A.P. | .9 | .1 | 2.6 | 68 | 672 |
| Celery soup, canned | | 2.1 | 2.8 | 5.0 | 243 | 187 |
| Cerealine | | 9.6 | 1.1 | 78.3 | 1640 | 28 |
| Chard | E.P. | 3.2 | .6 | 5.0 | 173 | 262 |
| Cheese, American pale | | 28.8 | 35.9 | .3 | 1990 | 23 |
| American red | | 29.6 | 38.3 | .... | 2102 | 22 |
| Cheddar | | 27.7 | 36.8 | 4.1 | 2080 | 22 |
| cottage | | 20.9 | 1.0 | 4.3 | 499 | 91 |
| full cream | | 25.9 | 33.7 | 2.4 | 1890 | 24 |
| Fromage de Brie | | 15.9 | 21.0 | 1.14 | 1170 | 39 |
| Neufchatel | | 18.7 | 27.4 | 1.5 | 1484 | 31 |
| Pineapple | | 29.9 | 38.9 | 2.6 | 2180 | 21 |
| Roquefort | | 22.6 | 29.5 | 1.8 | 1645 | 28 |
| Swiss | | 27.6 | 34.9 | 1.3 | 1945 | 23 |
| Cherries, fresh | E.P. | 1.0 | .8 | 16.7 | 354 | 128 |
| | A.P. | .9 | .8 | 15.9 | 337 | 134 |
| Cherries, canned | A.P. | 1.1 | .1 | 21.1 | 407 | 112 |
| Chestnuts, fresh | E.P. | 6.2 | 5.4 | 42.1 | 1098 | 41 |
| | A.P. | 5.2 | 4.5 | 35.4 | 920 | 49 |
| Chicken, broilers | E.P. | 21.5 | 2.5 | .... | 493 | 92 |
| | A.P. | 12.8 | 1.4 | .... | 289 | 157 |
| Chocolate | | 12.9 | 48.7 | 30.3 | 2768 | 16 |
| Cocoa | | 21.6 | 28.9 | 37.7 | 2258 | 20 |
| Cod, dressed | A.P. | 11.1 | .2 | .... | 209 | 217 |
| salt | E.P. | 25.4 | .3 | .... | 473 | 98 |
| | A.P. | 19.0 | .4 | .... | 361 | 126 |
| Consomme, canned | A.P. | 2.5 | .... | .4 | 53 | 862 |
| Corn, green, canned | | 2.8 | 1.2 | 19.0 | 455 | 102 |
| sweet, fresh | E.P. | 3.1 | 1.1 | 19.7 | 459 | 99 |
| | A.P. | 1.2 | .4 | 7.7 | 178 | 255 |
| Corn meal | | 9.2 | 1.9 | 75.4 | 1620 | 28 |
| Cow peas, dried | | 21.4 | 1.4 | 60.8 | 1550 | 29 |
| green | E.P. | 9.4 | .6 | 22.7 | 603 | 76 |
| Crackers, butter | A.P. | 9.6 | 10.1 | 71.6 | 1887 | 23 |
| cream | A.P. | 9.7 | 12.1 | 69.7 | 1938 | 23 |
| graham | A.P. | 10.0 | 9.4 | 73.8 | 1905 | 24 |
| soda | A.P. | 9.8 | 9.1 | 73.1 | 1875 | 24 |
| water | A.P. | 10.7 | 8.8 | 71.9 | 1855 | 24 |
| Cranberries | A.P. | .4 | .6 | 9.9 | 212 | 212 |
| Cream | | 2.5 | 18.5 | 4.5 | 883 | 50 |

*E. P. signifies edible portion; A. P. signifies as purchased.

TABLE XIII—CONT'D

| FOOD | | PROTEIN (N×6.25) PER CENT | FAT PER CENT | CARBO-HYDRATE PER CENT | FUEL VALUE PER POUND CALORIES | 100 CALORIE PORTION GRAMS |
|---|---|---|---|---|---|---|
| Cucumbers | E.P.* | .8 | .2 | 3.1 | 79 | 575 |
| | A.P.* | .7 | .2 | 2.6 | 68 | 666 |
| Currants, fresh | | 1.5 | .... | 12.8 | 259 | 175 |
| Dried Zante | | 2.4 | 1.7 | 74.2 | 1455 | 31 |
| Dandelion greens | | 2.4 | 1.0 | 10.6 | 277 | 164 |
| Dates, dried | E.P. | 2.1 | 2.8 | 78.4 | 1575 | 29 |
| | A.P. | 1.9 | 2.5 | 70.6 | 1416 | 32 |
| Doughnuts | | 6.7 | 21.0 | 53.1 | 1941 | 23 |
| Eggplant | E.P. | 1.2 | .3 | 5.1 | 126 | 349 |
| Eggs, uncooked | E.P. | 13.4 | 10.5 | .... | 672 | 68 |
| | A.P. | 11.9 | 9.3 | .... | 594 | 76 |
| Farina | | 11.0 | 1.4 | 76.3 | 1640 | 28 |
| Figs, dried | | 4.3 | .3 | 74.2 | 1437 | 32 |
| Flounder | A.P. | 5.4 | .3 | .... | 110 | 412 |
| | E.P. | 14.2 | .6 | .... | 282 | 161 |
| Flour, rye | | 6.8 | .9 | 78.7 | 1590 | 29 |
| wheat, California fine | | 7.9 | 1.4 | 76.4 | 1585 | 29 |
| wheat, entire | | 13.8 | 1.9 | 71.9 | 1630 | 28 |
| wheat, graham | | 13.3 | 2.2 | 71.4 | 1628 | 28 |
| wheat, patent baker's grade | | 13.3 | 1.5 | 72.7 | 1623 | 28 |
| wheat, straight grade | | 10.8 | 1.1 | 74.8 | 1608 | 28 |
| wheat, average high and medium | | 11.4 | 1.0 | 75.1 | 1610 | 28 |
| wheat, average low grade | | 14.0 | 1.9 | 71.2 | 1625 | 28 |
| Fowls | E.P. | 19.3 | 16.3 | .... | 1017 | 45 |
| | A.P. | 13.7 | 12.3 | .... | 752 | 60 |
| Gelatin | | 91.4 | .1 | .... | 1660 | 27 |
| Grape butter | | 1.2 | .1 | 58.5 | 1088 | 42 |
| Grapes | E.P. | 1.3 | 1.6 | 19.2 | 437 | 104 |
| | A.P. | 1.0 | 1.2 | 14.4 | 328 | 138 |
| Grapefruit | E.P. | .6 | .1 | 12.2 | 235 | 193 |
| | A.P. | .4 | .1 | 8.9 | 172 | 264 |
| Haddock | E.P. | 17.2 | .3 | .... | 324 | 140 |
| | A.P. | 8.4 | .2 | .... | 160 | 283 |
| Halibut steaks | E.P. | 18.6 | 5.2 | .... | 550 | 83 |
| | A.P. | 15.3 | 4.4 | .... | 457 | 100 |
| Ham, fresh, lean | E.P. | 25.0 | 14.4 | .... | 1042 | 44 |
| | A.P. | 24.8 | 14.2 | .... | 1030 | 44 |
| fresh, medium | E.P. | 15.3 | 28.9 | .... | 1458 | 31 |
| | A.P. | 13.5 | 25.9 | .... | 1303 | 35 |
| smoked, lean | E.P. | 19.8 | 20.8 | .... | 1209 | 38 |
| | A.P. | 17.5 | 18.5 | .... | 1073 | 42 |
| Herring, whole | E.P. | 19.5 | 7.1 | .... | 644 | 70 |
| | A.P. | 11.5 | 3.9 | .... | 362 | 125 |
| smoked | E.P. | 36.9 | 15.8 | .... | 1315 | 35 |
| | A.P. | 20.5 | 8.8 | .... | 731 | 62 |
| Hominy | | 8.3 | .6 | 79.0 | 1609 | 28 |
| Honey | | .4 | .... | 81.2 | 1481 | 31 |
| Huckleberries | | .6 | .6 | 16.6 | 336 | 135 |
| Kohl-rabi | E.P. | 2.0 | .1 | 5.5 | 140 | 324 |
| Koumiss | | 2.8 | 2.1 | 5.4 | 234 | 194 |
| Lamb, breast | E.P. | 19.1 | 23.6 | .... | 1311 | 35 |
| | A.P. | 15.4 | 19.1 | .... | 1058 | 43 |
| chops, broiled | E.P. | 21.7 | 29.9 | .... | 1614 | 28 |
| fore quarter | E.P. | 18.3 | 25.8 | .... | 1385 | 33 |
| | A.P. | 14.9 | 21.0 | .... | 1127 | 40 |

*E. P. signifies edible portion; A. P. signifies as purchased.

TABLE XIII—CONT'D

| FOOD | | PROTEIN (N×6.25) PER CENT | FAT PER CENT | CARBO-HYDRATE PER CENT | FUEL VALUE PER POUND CALORIES | 100 CALORIE PORTION GRAMS |
|---|---|---|---|---|---|---|
| Lamb, hind quarter | E.P.* | 19.6 | 19.1 | .... | 1149 | 40 |
| | A.P.* | 16.5 | 16.1 | .... | 953 | 48 |
| leg, roast | | 19.7 | 12.7 | .... | 876 | 52 |
| side | E.P. | 17.6 | 23.1 | .... | 1263 | 36 |
| | A.P. | 14.1 | 18.7 | .... | 1015 | 45 |
| Lard, refined | | .... | 100.0 | .... | 4080 | 11 |
| Lemon juice | | .... | .... | 9.8 | 178 | 255 |
| Lemons | E.P. | 1.0 | .7 | 8.5 | 201 | 226 |
| | A.P. | .7 | .5 | 5.9 | 140 | 323 |
| Lettuce | E.P. | 1.2 | .3 | 2.9 | 87 | 525 |
| | A.P. | 1.0 | .2 | 2.5 | 72 | 633 |
| Liver, beef | E.P. | 20.4 | 4.5 | 1.7 | 583 | 78 |
| | A.P. | 20.2 | 3.1 | 2.5 | 538 | 84 |
| veal | E.P. | 19.0 | 5.3 | .... | 562 | 81 |
| Lobster, whole | E.P. | 16.4 | 1.8 | .4 | 379 | 120 |
| | A.P. | 5.9 | .7 | .2 | 139 | 326 |
| canned | A.P. | 18.1 | 1.1 | .5 | 382 | 119 |
| Macaroni | | 13.4 | .9 | 74.1 | 1625 | 28 |
| Macaroons | | 6.5 | 15.2 | 65.2 | 1922 | 24 |
| Mackerel | E.P. | 18.7 | 7.1 | .... | 629 | 72 |
| | A.P. | 10.2 | 4.2 | .... | 356 | 127 |
| salt | E.P. | 21.1 | 22.6 | .... | 1305 | 35 |
| | A.P. | 16.3 | 17.4 | .... | 1005 | 45 |
| Marmalade, orange | | .6 | .1 | 84.5 | 1548 | 29 |
| Milk, condensed, sweetened | | 8.8 | 8.3 | 54.1 | 1480 | 31 |
| skimmed | | 3.4 | .3 | 5.1 | 167 | 273 |
| whole | | 3.3 | 4.0 | 5.0 | 314 | 145 |
| Mince meat, commercial | | 6.7 | 1.4 | 60.2 | 1280 | 36 |
| homemade | | 4.8 | 6.7 | 32.1 | 942 | 48 |
| Molasses, cane | | 2.4 | .... | 69.3 | 1302 | 35 |
| Mushrooms | A.P. | 3.5 | .4 | 6.8 | 204 | 223 |
| Muskmelons | E.P. | .6 | .... | 9.3 | 180 | 252 |
| | A.P. | .3 | .... | 4.6 | 89 | 510 |
| Mutton, forequarter | E.P. | 15.6 | 30.9 | .... | 1543 | 29 |
| | A.P. | 12.3 | 24.5 | .... | 1223 | 37 |
| hind quarter | E.P. | 16.7 | 28.1 | .... | 1450 | 31 |
| | A.P. | 13.8 | 23.2 | .... | 1197 | 38 |
| Mutton, leg | E.P. | 19.8 | 12.4 | .... | 863 | 52 |
| | A.P. | 16.5 | 10.3 | .... | 718 | 63 |
| side | A.P. | 13.0 | 24.0 | .... | 1215 | 37 |
| | E.P. | 16.2 | 29.8 | .... | 1512 | 30 |
| Nectarines | E.P. | .6 | .... | 15.9 | 299 | 152 |
| | A.P. | .6 | .... | 14.8 | 280 | 162 |
| Oatmeal | | 16.1 | 7.2 | 67.5 | 1811 | 25 |
| Okra | E.P. | 1.6 | .2 | 7.4 | 172 | 264 |
| | A.P. | 1.4 | .2 | 6.5 | 152 | 300 |
| Olives, green | E.P. | 1.1 | 27.6 | 11.6 | 1357 | 33 |
| | A.P. | .8 | 20.2 | 8.5 | 995 | 46 |
| ripe | E.P. | 1.7 | 25.0 | 4.3 | 1130 | 40 |
| | A.P. | 1.4 | 21.0 | 3.5 | 947 | 48 |
| Onions, fresh | E.P. | 1.6 | .3 | 9.9 | 220 | 206 |
| | A.P. | 1.4 | .3 | 8.9 | 199 | 228 |
| Oranges | E.P. | .8 | .2 | 11.6 | 233 | 195 |
| | A.P. | .6 | .1 | 8.5 | 169 | 268 |
| Oxtail soup, canned | A.P. | 3.8 | .5 | 4.2 | 166 | 274 |

*E. P. signifies edible portion; A. P. signifies as purchased.

TABLE XIII—CONT'D

| FOOD | | PROTEIN (N×6.25) PER CENT | FAT PER CENT | CARBO-HYDRATE PER CENT | FUEL VALUE PER POUND CALORIES | 100 CALORIE PORTION GRAMS |
|---|---|---|---|---|---|---|
| Oysters, in shell | E.P.* | 6.2 | 1.2 | 3.7 | 228 | 199 |
| | A.P.* | 1.2 | .2 | .7 | 43 | 1065 |
| canned | A.P. | 8.8 | 2.4 | 3.9 | 328 | 138 |
| Parsnips | E.P. | 1.6 | .5 | 13.5 | 294 | 154 |
| | A.P. | 1.3 | .4 | 10.8 | 236 | 192 |
| Pea soup, canned | A.P. | 3.6 | .7 | 7.6 | 232 | 196 |
| Peaches, canned | A.P. | .7 | .1 | 10.8 | 213 | 213 |
| fresh | E.P. | .7 | .1 | 9.4 | 188 | 242 |
| | A.P. | .5 | .1 | 7.7 | 153 | 297 |
| Peanuts | E.P. | 25.8 | 38.6 | 24.4 | 2490 | 18 |
| | A.P. | 19.5 | 29.1 | 18.5 | 1877 | 24 |
| Pears, fresh | E.P. | .6 | .5 | 14.1 | 288 | 158 |
| | A.P. | .5 | .4 | 12.7 | 256 | 177 |
| Peas, canned | A.P. | 3.6 | .2 | 9.8 | 252 | 180 |
| dried | | 24.6 | 1.0 | 2.0 | 1611 | 28 |
| green | E.P. | 7.0 | .5 | 16.9 | 454 | 100 |
| | A.P. | 3.6 | .2 | 9.8 | 252 | 180 |
| Peppers, green | E.P. | 1.1 | .1 | 4.6 | 109 | 417 |
| Persimmons | E.P. | .8 | .7 | 31.5 | 615 | 74 |
| Pies, apple | | 3.1 | 9.8 | 42.8 | 1233 | 37 |
| custard | | 4.2 | 6.3 | 26.1 | 806 | 56 |
| lemon | | 3.6 | 10.1 | 37.4 | 1156 | 39 |
| mince | | 5.8 | 12.3 | 38.1 | 1300 | 35 |
| squash | | 4.4 | 8.4 | 21.7 | 817 | 56 |
| Pineapples, fresh | E.P. | .4 | .3 | 9.7 | 196 | 232 |
| canned | A.P. | .4 | .7 | 36.4 | 695 | 65 |
| Pine nuts (pignolias) | | 33.9 | 49.4 | 6.9 | 2757 | 16 |
| Pistachios, shelled | | 22.3 | 54.0 | 16.3 | 2900 | 16 |
| Plums | E.P. | 1.0 | .... | 20.1 | 383 | 118 |
| | A.P. | .9 | .... | 19.1 | 363 | 125 |
| Pomegranates | E.P. | 1.5 | 1.6 | 19.5 | 447 | 102 |
| Pork, chops, medium | E.P. | 16.6 | 30.1 | .... | 1530 | 30 |
| | A.P. | 13.4 | 24.2 | .... | 1230 | 37 |
| chuck ribs and shoulder | E.P. | 17.3 | 31.1 | .... | 1585 | 29 |
| | A.P. | 14.1 | 25.5 | .... | 1298 | 35 |
| fat, salt | A.P. | 1.9 | 86.2 | .... | 3555 | 13 |
| sausage | A.P. | 13.0 | 44.2 | 1.1 | 2030 | 22 |
| side | E.P. | 9.1 | 55.3 | .... | 2423 | 19 |
| | A.P. | 8.0 | 49.0 | .... | 2145 | 21 |
| tenderloin | A.P. | 18.9 | 13.0 | .... | 875 | 52 |
| Potato chips | A.P. | 6.8 | 39.8 | 46.7 | 2598 | 17 |
| Potatoes, white, raw | E.P. | 2.2 | .1 | 18.4 | 378 | 120 |
| | A.P. | 1.8 | .1 | 14.7 | 302 | 149 |
| sweet, raw | E.P. | 1.8 | .7 | 27.4 | 558 | 81 |
| | A.P. | 1.4 | .6 | 21.9 | 447 | 102 |
| Prunes, dried | E.P. | 2.1 | .... | 73.3 | 1368 | 33 |
| | A.P. | 1.8 | .... | 62.2 | 1160 | 39 |
| Pumpkins | E.P. | 1.0 | .1 | 5.2 | 117 | 389 |
| | A.P. | .5 | .1 | 2.6 | 60 | 753 |
| Radishes | E.P. | 1.3 | .1 | 5.8 | 133 | 341 |
| | A.P. | .9 | .1 | 4.0 | 91 | 488 |
| Raisins | E.P. | 2.6 | 3.3 | 76.1 | 1562 | 29 |
| | A.P. | 2.3 | 3.0 | 68.5 | 1407 | 32 |

*E. P. signifies edible portion; A. P. signifies as purchased.

TABLE XIII—CONT'D

| FOOD | | PROTEIN (N×6.25) PER CENT | FAT PER CENT | CARBO-HYDRATE PER CENT | FUEL VALUE PER POUND CALORIES | 100 CALORIE PORTION GRAMS |
|---|---|---|---|---|---|---|
| Raspberries, red | | 1.0 | .... | 12.6 | 300 | 184 |
| black | | 1.7 | 1.0 | 12.6 | 300 | 151 |
| Rhubarb | E.P.* | .6 | .7 | 3.6 | 105 | 433 |
| | A.P.* | .4 | .4 | 2.2 | 63 | 714 |
| Rice | | 8.0 | .3 | 79.0 | 1591 | 29 |
| Salmon, dressed | A.P. | 13.8 | 8.1 | .... | 582 | 78 |
| whole | E.P. | 22.0 | 12.8 | .... | 923 | 49 |
| | A.P. | 15.3 | 8.9 | .... | 642 | 71 |
| Sausage, Bologna | E.P. | 18.7 | 17.6 | .3 | 1061 | 43 |
| | A.P. | 18.2 | 19.7 | .... | 1135 | 40 |
| farmer | E.P. | 29.0 | 42.0 | .... | 2240 | 20 |
| | A.P. | 27.9 | 40.4 | .... | 2156 | 21 |
| Shad, whole | E.P. | 18.8 | 9.5 | .... | 727 | 61 |
| | A.P. | 9.4 | 4.8 | .... | 367 | 124 |
| roe | | 20.9 | 3.8 | 2.6 | 582 | 78 |
| Shredded wheat | | 10.5 | 1.4 | 77.9 | 1660 | 27 |
| Spinach, fresh | A.P. | 2.1 | .3 | 3.2 | 109 | 417 |
| Squash | E.P. | 1.4 | .5 | 9.0 | 209 | 217 |
| | A.P. | .7 | .2 | 4.5 | 103 | 443 |
| Strawberries | | 1.0 | .6 | 7.4 | 169 | 269 |
| Succotash, canned | | 3.6 | 1.0 | 18.6 | 444 | 102 |
| Sugar | | .... | .... | 100.0 | 1815 | 25 |
| Tomatoes, fresh | A.P. | .9 | .4 | 3.9 | 104 | 438 |
| canned | A.P. | 1.2 | .2 | 4.0 | 103 | 443 |
| Tunny fish | E.P. | 26.6 | 11.4 | .... | 946 | 48 |
| Turkey | E.P. | 21.1 | 22.9 | .... | 1320 | 34 |
| | A.P. | 16.1 | 18.4 | .... | 1042 | 43 |
| sandwich, canned | | 20.7 | 29.2 | .... | 1568 | 29 |
| Turnips | E.P. | 1.3 | .2 | 8.1 | 178 | 256 |
| | A.P. | .9 | .1 | 5.7 | 124 | 367 |
| Veal, breast | E.P. | 20.3 | 11.0 | .... | 817 | 56 |
| | A.P. | 15.3 | 8.6 | .... | 629 | 72 |
| cutlet | E.P. | 20.3 | 7.7 | .... | 683 | 66 |
| | A.P. | 20.1 | 7.5 | .... | 670 | 68 |
| forequarter | E.P. | 20.0 | 8.0 | .... | 690 | 66 |
| | A.P. | 15.1 | 6.0 | .... | 517 | 88 |
| hindquarter | E.P. | 20.7 | 8.3 | .... | 715 | 64 |
| | A.P. | 16.2 | 6.6 | .... | 534 | 85 |
| side | E.P. | 20.2 | 8.1 | .... | 697 | 65 |
| | A.P. | 15.6 | 6.3 | .... | 539 | 84 |
| Vegetable soup, canned | | 2.9 | .... | .5 | 62 | 735 |
| Walnuts, California or English | E.P. | 18.4 | 64.4 | 13.0 | 3199 | 14 |
| | A.P. | 4.9 | 17.3 | 3.5 | 859 | 53 |
| black | E.P. | 27.6 | 56.3 | 11.7 | 3011 | 15 |
| | A.P. | 7.2 | 14.6 | 3.0 | 780 | 59 |
| Watermelons | E.P. | .4 | .2 | 6.7 | 136 | 332 |
| | A.P. | .2 | .1 | 2.7 | 57 | 800 |
| Wheat, cracked | | 11.1 | 1.7 | 75.5 | 1635 | 28 |
| Whitefish | E.P. | 22.9 | 6.5 | .... | 680 | 67 |
| | A.P. | 10.6 | 3.0 | .... | 315 | 144 |
| Zwieback | | 9.8 | 9.9 | 73.5 | 1915 | 24 |

*E. P. signifies edible portion; A. P. signifies as purchased.

## IV. DIET IN DISEASE

In prescribing diets for the sick it is no more advisable to have rigid lists of articles to eat and to avoid than it is in prescribing drugs to have fixed sets of prescriptions to administer. The principles of dietary treatment should be mastered and the menu varied accordingly to suit the patient's individual needs. But, just as in learning prescription writing it is well to fix firmly in memory a few good prescriptions and then learn to vary and substitute them, so in dietetics it is well to be familiar with a few set diets, and learn to vary them from that standard. In this spirit the following diets are set down. They may be copied out and handed to patients with an explanatory discussion. In many instances the diet list here given has been used as a standard set of instructions for my own patients. Sets of diets are kept in a book in the office and copied out in typewriting for the patient. Often they are changed in many details.

The standardized hospital diets here given are those suggested by Baumgarten, Fischel and Soper in a recent article and are copied by permission. The purin-free diet, the nephritic diets, the diet for cardiac compensation and fever diet (in part) are also taken from their excellent lists.

### A. Standardized Hospital Diets

1. Liquid Diet: Feedings every two hours, 6 oz. each.
   Meat broths.
   Meat juices.
   Strained soups.
   Fruit juices with water.
   Albuminized drinks.
   Cereal gruels.
   Tea.
   Coffee.
   Cocoa (if permitted),
   Milk (if permitted).
   Bulgarian milk.

2. Soft Diet: Feedings every three hours.
   Any liquid food.
   Cream soups.
   Milk—whole and Bulgarian.
   Custards.
   Junkets.
   Ice cream and ices.

Gelatin.
Cereals.
Eggs—soft cooked.
Milk toast—butter.
Stewed fruits—well cooked and strained.
Cottage cheese.
Tapioca.
Rice.
Blanc Mange.

3. Light Diet: A. Any liquid food or foods on Soft Diet—
   Vegetables, purée of.
   Potatoes, baked or mashed.
   Rice.
   Desserts: Tapioca, rice, cornstarch puddings, prune whip.
   Bread: White and whole wheat.
   Fruits: Fresh and stewed; baked apples.
   Jellies and preserves.

4. Light Diet: B. Light Diet A with the addition of:
   Meats: Chicken.
   Sweetbreads.
   Lamb chops.
   Tender steak.
   Fish and oysters.
   All cooked vegetables.

5. General Hospital Diet:
   Breakfast:
   Orange, grapefruit, berries or other fresh fruit.
   Stewed fruits.
   Shredded wheat biscuits, Dr. Price's All-grain Food, Ralston's Breakfast Food, rolled oats, bran or cracked wheat, with cream and little sugar.
   Eggs, soft cooked, 7 minutes, or poached.
   Corn muffins, graham muffins with butter, honey, syrup.
   White bread, toast, Vienna rolls.
   One cup coffee or cup of cocoa or glass of hot water and cream.

   Dinner:
   Creamed vegetable soup. Meat broths. Meat soups without fat. Roast beef, roast lamb, roast chicken, roast turkey, without dressing. Cranberry jelly. Fruit jellies.

Stewed chicken, stewed lamb. Boiled and baked ham.
Broiled steak, broiled lamb chops. Fresh fish, baked.
Stewed or baked white onions, cauliflower, peas, corn, lima beans, okra, stewed or baked tomatoes, baked or broiled egg plant, artichokes, beets, oyster plant.

Supper:
Mixed vegetable soups. Creamed vegetable soups.
Spaghetti. Schmierkäse. Boston baked beans.
Eggs: poached, soft cooked, omelet.
Vegetables, same as lunch.
White, graham, whole wheat, rye, or corn bread, or toast, Vienna rolls, corn muffins, with butter, honey, syrup.
Stewed fruits. Raw fruits.
Custards, gelatins, cornstarches, tapioca, blanc mange, prune whip, junket.
Bulgarian milk, glass of hot water and cream or cool water.

6. Postoperative Diets:

*For General Cases:*

First Day: 3 per cent glucose and 2 per cent sod. citrate as proctoclysis. Water as tolerated.

Second Day: Feedings every two-third hours. Liquid foods as: broths, albuminized drinks (e.g., orange and lemon). Bulgarian buttermilk, tea, coffee without cream.

Third Day: Three meals a day, with nourishment at 10:30 A.M., 4:00 P.M. and 8:00 P.M. Soft diet as: Custards, blanc mange, ice cream, cereals, junket, cream soups, gelatin, soft cooked eggs, milk, milk toast.

Fourth Day: Same as third.

Fifth Day: Light diet as scheduled in Light Diet List.

Sixth and Seventh Days: Same as on fifth day. After that Light Diet B unless otherwise specified.

*Stomach Cases:*

First Day: 3 per cent glucose and 2 per cent sod. citrate as proctoclysis. Water as tolerated.

Second Day: Junket or oatmeal jelly (2 per cent) at a feeding every 3 hours. Continue glucose as proctoclysis.

Third Day: Feed every 2 hours. Junket, oatmeal jelly and Bulgarian milk and cream (⅔ and ⅓); 2 oz. at a feeding.

7:00 A.M. Junket.
9:00 A.M. Oatmeal jelly.
11:00 A.M. Bulgarian milk.
1:00 P.M. Junket.
3:00 P.M. Oatmeal jelly.
5:00 P.M. Bulgarian milk.
7:00 P.M. Junket.

(One or two feedings during the night if awake.)

Fourth Day: Feed every 2 hours. Same as on third postoperative day with the addition of custards, blanc mange, gelatin, served with sugar or milk and cream. One 7 minute egg.

Fifth Day: Increase quantity to 4 oz. with feedings every two and one-half hours apart. Use same foods as on fourth day.

Sixth and Seventh Days: Same as Fifth.

*For Colon and Rectal Cases:*

First Day: Water as tolerated.

Second Day: Feedings every 2½ hours, alternating the following foods: 8 oz. meat broths, 6 oz. Bulgarian milk, 2 coddled eggs.

Third and Fourth Days: Same as second.

Fifth Day: Serve three meals a day with intermediate broth feedings. Add to the above diet beef, lamb, fish and poultry (roasted, boiled, or broiled); eggs (soft cooked, scrambled, omelet).

Sixth to Twelfth Day: Same as fifth day.

Ninth Day: Change to Light Diet B.

### B. Diets in Gastrointestinal Disease

Attention is particularly called to the first three of the following diets. They are intended to be a graded set of diets for more or less severe gastrointestinal disease. The first is the Sippy ulcer diet. The second is more palatable, and contains a greater variety of food, than the Sippy diet, but is still a very bland, easily digested diet. It may be used as the

first step the ulcer patient takes away from the rigid Sippy diet towards fuller dietary habits of living. It may be prescribed at the beginning for a patient less sick than the patient who needs to be put on the Sippy diet. It may be used particularly for diarrhea, for achylia (because it requires no elaborate amount of digestion), for mucous colitis, for chronic gastric catarrh (if any such disease exists), for atony, for gastroptosis (those patients with prominent gastric symptoms—belching, and discomfort after meals largely due to stasis) and for the severer grades of functional hyperacidity. The third diet is a further advance—while still nonstimulating and reasonably easily digested it contains quite a little solid food. These diets may be varied to suit the needs of nearly any gastric or "colitis" case.

*Diet I.* Simplest form of nonirritating, nonstimulating, residue-free diet. Sippy diet for gastric ulcer.

| | |
|---|---|
| 7:00 A.M. | One and one-half ounces milk mixed with one and one-half ounces cream. Cool. |
| 8:00 A.M. | One and one-half ounces milk mixed with one and one-half ounces cream. Cool. |
| 9:00 A.M. | Ditto. |
| 10:00 A.M. | Ditto. |
| 11:00 A.M. | Ditto. |
| 12:00 NOON. | Ditto. |
| 1:00 P.M. | Ditto. |
| 2:00 P.M. | Ditto. |
| 3:00 P.M. | Ditto. |
| 4:00 P.M. | Ditto. |
| 5:00 P.M. | Ditto. |
| 6:00 P.M. | Ditto. |
| 7:00 P.M. | Ditto. |

(Adjuvants of the Sippy Diet for Ulcer)

During the first stages of the treatment of gastric ulcer Sippy recommended besides the above diet:

1. Rest in bed for three weeks. Ice bag to the epigastrium. At the bedside a table with a thermos bottle filled with the milk-cream mixture, a glass, a teaspoon, some water, and alkaline powders of calcium carbonate and sodium bicarbonate, and of magnesium oxide and sodium bicarbonate.

2. On the hour, with the milk and cream mixture, the patient takes a powder containing magnesium oxide grains 10 and sodium bicarbonate grains 10.

3. Between each feeding, at 7:30 A.M., 8:30 A.M., 9:30 A.M., and so on until evening the patient takes a powder containing calcium carbonate grains 10 and sodium bicarbonate grains 30.

4. At 9:30 P.M. the stomach is aspirated and all its contents removed. This is a very important part of the treatment as it frees the stomach from stagnating remnants and acid gastric juice which will irritate the surface of the ulcer during the long sleep period when no neutralizing substances are ingested. If during the course of the treatment the amount of the gastric juice removed at this time falls below 25 c.c. this nightly aspiration can be discontinued.

*Diet II.* Nonirritating residue-free, easily digested. For achylia, gastritis, gastroptosis, diarrhea, colitis, secretory gastric disorders and second stage ulcer cures.

Cream vegetable soups—tomato, pea, celery, etc.
Oatmeal and rice—These should be thoroughly boiled for at least 2 hours in order to break up cellulose husks. Should be served with cream and sugar.
Eggs—soft boiled, poached, coddled, scrambled.
Toast and toasted crackers.
Potatoes—mashed and baked.
Mashed peas, carrots.
Spinach.
Ice cream and ices.
Custards.
Tapioca.
Wine Jelly.
Rice Pudding.
Orange Juice.

Avoid fried foods, meat of all kinds, fruit, vegetables with a heavy residue, salads, highly spiced foods and butter.

*Diet III.* Easily digested, nonstimulating. For hyperacidity, ambulatory ulcer cases, secretory disorders.

Diet Instructions to Patient.—The best plan is a divided diet, small meals and often. Separate eating from drinking. Avoid the three S's—Sweet, Sour, Spice. Avoid candy, pastries, soggy foods of all kinds—such as heavy puddings and soggy desserts; avoid fried meats and fatty meats such as fat fish. Your cereals, such as rice and oatmeal, should be boiled three to four hours before eating. Never use white bread except the crust, or have it toasted. White bread toasted may be eaten.

The best food for you is lean, tender meat broiled such as the breast of lean young chicken, steak, roast beef or lean fish and oysters. Toast, cream vegetable soup, mashed potatoes, peas, beans, well-cooked cereals, eggs in any form and milk and cream. A glass of half milk and half cream taken with meals and in the middle of the morning, middle of the afternoon and before going to bed at night, will give you a great deal of relief. This diet will be excellent for your bowels. A sample day's diet is as follows:

| | |
|---|---|
| 7:30 A.M. | Oatmeal or rice, 2 eggs, toast, coffee with cream and sugar. |
| 10:30 A.M. | Glass of half milk and half cream, or milk and crackers. |
| 1:00 P.M. | Broiled meat, mashed potato, toast, butter, glass of milk, or cocoa. |
| 3:30 P.M. | Same as 10:30 A.M. |
| 6:00 P.M. | Vegetable soup, toast, broiled meat, baked potato, green vegetables—such as green peas or spinach—coffee with cream and sugar. |
| 10:00 P.M. | Oysters and crackers, or a cold meat sandwich, or a glass of half milk and half cream. |

*Diets IV and V.* Alternate régimes for ulcer.

*Diet IV.* Coleman's diet for peptic ulcer.

Warren Coleman, in 1924, proposed a diet for peptic ulcer, based upon withholding food from the stomach as long as possible in order to inhibit the secretion of hydrochloric acid. Hydrochloric acid, he thought, was secreted largely on account of the ingestion of food, and certainly the presence of hydrochloric acid prevents the ulcer from healing. For the first three to five days of treatment the patient is given no food whatever by mouth. If thirst is not controlled by the enemas, small quantities of water, from 1 to 3 ounces, at room temperature or warmer, may be allowed whenever desired. Glucose enemas are begun on the first day of treatment. They are composed of 30 gm. of glucose in 300 c.c. of normal salt solution. The glucose is given hot from a vacuum bottle, into the empty rectum at a slow rate—half to three-quarters of an hour being consumed to absorb one. Three or four of them are given a day. Food by mouth is begun on the fourth to sixth day. White of egg, olive oil and butter fat are the only foods given. The eggwhite is given at a different time than the fats. Two hours is the interval between feedings—

longer if possible. The amount of olive oil given at first is 1½ to 2½ ounces, later increased to 5 ounces per day. Four or five, later six or eight whites of eggs are given per day. This régime is continued for three to four weeks.

*Diet V.* Vanderhoff's diet in duodenal ulcer.

1. *Frequent feeding.* The most important part of treatment is to secure the buffer effect of the food by frequent feeding. In patients with acute pain and marked pylorospasm, the ideal food is 2 oz. (60 c.c.) each of cream and sweet milk to which is added 10 grains (0.65 gm.) sodium citrate, given once every hour from 7 A.M. to 9 P.M. In the average instance of chronic duodenal ulcer, however, six feedings a day suffice, and the patient is instructed never to go more than three hours while awake without putting food into the stomach. The food between meals and at bedtime may consist of a glass of sweet milk or a milk shake with egg. When this is not convenient a good substitute is cream cheese with crackers and butter.

2. *Diet.* Except for the acute cases and those in which there is hemorrhage, the patient is given a liberal diet, and it should be explained to the individual with a chronic duodenal ulcer that he does not have indigestion but rather too much digestion. These patients are told to eat a general diet with the exception of seven types of food which are to be avoided: (1) all acids, such as vinegar, pickles, and sour foods; (2) raw fruits, especially apples, grapes, and citrus fruits; (3) soups and meat extractives; (4) condiments and spices, such as an excess of salt and pepper, mustard and horseradish; (5) intense sweets, such as honey, molasses and candy; (6) very coarse foods, as nuts and corn; (7) alcohol in every form, but especially sour wines, cider, and grape juice. The best food for patients with ulcer is fat, such as cream, butter, and olive oil; and the next best food is albumin in some form, and they are told to partake freely of milk, eggs, and all kinds of cooked meats.

3. *Belladonna.* The third item in the treatment, which may not be essential, but certainly appears to be helpful and indicated, is the administration of atropine or belladonna. In my series this is given in the form of the tincture of belladonna, 10 drops in water three times a day before the regular meals. This tends to release pylorospasm and hyperperistalsis, and possibly reduces the total acid secretion of the gastric glands.

4. *Bismuth.* After the three regular meals, and again at bedtime, the patient is given a level teaspoonful of bismuth subcarbonate. If this should be constipating a small amount of heavy magnesium oxide may be added. Sodium bicarbonate is not used, and careful observation has never shown an instance of alkalosis during treatment.

5. *Duration of treatment.* The treatment must be carried out regularly and persistently over a period of two years. If omitted for one or two days, it is conceivable that the healing of the ulcer may be delayed thirty days or more.

6. *Control of patient* is undoubtedly the most difficult part of the treatment. Failures of medical therapy with recurrence of symptoms are inevitable if the patient becomes at all careless or forgetful, or considers himself cured because of prompt relief from suffering. The number of medical cures is largely in proportion to the intelligence of the patient and the painstaking explanation of the physician for each part of the treatment, with insistance on punctuality at feedings and absolute regularity of the régime. As a control and check on the treatment the patient is instructed to report once each six months for the two years period. Each time this is done the patient is again roentgenographed by the same roentgenologist who made the original study. Six months after treatment is instituted the deformity in the duodenum may have disappeared. In other instances the outlines of the defect are found to be smoother, gastric hyperperistalsis has decreased, and hypermotility has diminished. Treatment for the full two years is continued regardless of the improvement noted on roentgen-ray examination. Five such examinations are made during the two-year treatment, and it is a rare observation not to see the ulcer deformity either disappear or undergo a decided change in appearance compatible with a healed scar. These interviews with each patient at intervals of six months give the physician the opportunity to review the principles of the treatment and to emphasize the absolute necessity of strict adherence to the details involved.

7. *Subsidiary treatment* consists in the attempt to correct any other physical impairment with special emphasis on the removal of chronic foci of infection in the tonsils, sinuses and about the teeth. Cases of concurrent chronic appendicitis and chronic cholecystitis are treated surgically before the ulcer treatment is instituted but, with the consent and knowledge of the patient, the cooperating surgeon is instructed not to perform any operation on an otherwise uncomplicated duodenal ulcer.

8. *Subsequent care.* At the expiration of two years all medication is discontinued. The patient is told he may eat what he wishes, except that he should avoid acids, intense sweets, an excess of condiments and especially cider, grape juice, and sour wines. It is also advisable that a patient with a healed duodenal ulcer should not go too long without food, and many patients continue to eat between meals and at bedtime although not with the exact regularity required during the period of treatment.

*Diet VI.* High residue content for constipation.

Arrange your meals systematically and stick to your schedule.

Drink plenty of water between meals.

Drink one or 2 glasses of hot water immediately on arising.

Eat some fresh or cooked fruit every night before going to bed—an apple, orange, pear or peach.

Soups: Meat broths, stock soups with vegetables.

Meats: Raw oysters, fresh fish, poultry, fresh meat of almost any kind except pork.

Vegetables: Spinach, peas, green corn, string beans, cauliflower, cabbage, lettuce, celery, onions and tomatoes.

Cereals: Oats, wheatena, mush, (graham or corn meal), hominy grits. (Cereals are better cooked with ⅓ bran.)

Breads: Bran, whole wheat, graham, rye, corn.

Fats: Olive oil, butter and bacon.

Fruits: Prunes, dates, figs, raisins, oranges, apples, berries with seeds, peaches, melons.

Fluids: Water in abundance, weak coffee, new cider, unfermented grape-juice, buttermilk.

Cake: Ginger bread, ginger snaps.

Desserts: Ices, light apple, date or fig puddings, gelatins, agar-agar.

Miscellaneous: Marmalade, honey, molasses in moderate amounts.

Avoid: Tea, cocoa, chocolate, spirituous liquors, rice, tapioca, farina, pineapple, cheese, nuts, sweet milk, eggs, salted fish or meats, rich puddings or pastries, fried foods.

Remarks: Two glasses of water (hot or cold) taken before breakfast and fruit before retiring are especially beneficial. Balance the meals, that is, have variety each time, using meat, vegetables, fruits, etc., with each meal.

*Diet VII.* Fat-free diet for jaundice, cirrhosis of the liver:

Soups: Stock soups, meat broths, from which all fat has been removed.

Vegetables: Fresh and cooked, except peas, carrots and sweet vegetables.

Fruits: Oranges, lemons, grapefruit, unsweetened stewed fruits.

Cereals: Wheat, barley and rice cereals; sago and tapioca.

Fluids: Water, orange and lemonades; whey or skimmed milk sometimes allowed; weak tea or coffee.

Breads: White bread, graham, rye, toast, crackers.

Meats: Lean beef, lamb, chicken, squab, white or lean fish (small amounts).

Desserts: Gelatins and fruits.

### C. Diets for Metabolic Diseases

*Diet 1. Diabetes.*—The treatment of diabetes, although it is almost exclusively dietetic, is so intimately associated with a knowledge of the pathologic physiology of diabetes, that consideration of diets for the diabetic will be postponed until a discussion of the whole subject is possible.

*Diet 2. Obesity. Low Caloric Content Diets.*—

a. Banting's Diet:

Breakfast, 8 A.M.: 150 to 180 gm. (5 to 6 oz.) meat or broiled fish (not a fat variety of either); a small biscuit or 30 gm. (1 oz.) dry toast; a large cup of tea or coffee without cream, milk or sugar.

Dinner, 1 P.M.: Meat or fish as at breakfast, or any kind of game or poultry, same amount; any vegetable except those that grow under ground, such as potatoes, parsnips, carrots or beets; dry toast, 30 gm. (1 oz.); cooked fruit without sugar; good claret, 300 c.c. (10 oz.). Madeira or sherry.

Tea, 5 P.M.: Cooked fruit, 60 to 90 gm. (2 to 3 oz.); 1 or 2 pieces zweibach; tea, 270 c.c. (9 oz.) without milk, cream or sugar.

Supper, 8 P.M.: Meat or fish as at dinner, 90 to 120 c.c. (3 to 4 oz.); claret or sherry, water, 210 c.c. (7 oz.)

Fluids restricted to 1050 c.c. (35 oz.) per day.

b. Ebstein's Diet:

Ebstein believed that it was possible to allow more fat—up to 180 grams a day in obesity diets. He, however, reduced the carbohydrates to almost nothing, forbidding all sugars, sweets and potatoes.

Breakfast: One large cup black tea, without cream, milk or sugar; white or brown bread, 60 gms. (2 oz.) with plenty of butter.

Dinner: 2 P.M. Clear soup, meat 120 to 180 (4 to 6 oz.) with gravy and fat meat is especially recommended; vegetables in abundance (as noted above); small amount of fresh or stewed fruit (without sugar) or salad; 2 or 3 glasses light wine. Shortly after dinner a cup of tea is allowed with sugar or milk.

Supper: 7:30 P.M. Large cup tea, without sugar or milk; 1 egg with or without small portion meat, preferably fat. Occasionally a little cheese or fresh fruit.

Total values: Protein, 100 gm. (3½ oz.); fat, 85 gm. (3 oz.); carbohydrate, 50 gm. (2⅔ oz.).

c. Galisch's Diet:

The idea of this cure is that most of the food is taken early in the day and almost none in the evening, so that during the night there is less food to be absorbed, that is, during the period of absolute bodily rest.

Early morning. Tea with white bread and butter.

10 A.M. One egg with a little bread and butter.

1 P.M. Meat and vegetable, a little sauce, potato, salad and stewed fruit.

Afternoon: Coffee with zweibach or white bread and a little butter.

Evening: Small piece bread and butter. Little beer or wine.

*Diet 3. Purin-free. Gout.*

Breakfast: One serving fresh or stewed fruit (100 gm.), 4 oz. farina, cream of wheat, etc., excepting oatmeal, 2 oz. cream, 1 T. sugar, 30 gm. toast with 15 gm. butter, 6 oz. milk, 1 egg.

Lunch: 6 oz. cream soup, 1 medium size baked potato, green vegetables with butter, 2 sl. bread (60 gm.), 30 gm. butter (2T.), light dessert: rice, tapioca or cornstarch pudding, 6 oz. milk, 1 serv. cottage cheese.

Dinner: 6 oz. cream soup, 1 serv. boiled rice with 2 oz. cream, vegetables (excepting legumes) with butter, 1 egg, 1 sl. bread (30 gm.), 2 sq. butter, 1 serv. stewed or fresh fruit, 6 oz. milk.

### D. Diets for Nephritis and High Blood Pressure

*Diet 1. Salt-free.*

Salt-free bread 200 gm., salt-free butter 50 gm., salt-free beans or rice 250 gm., meat (beef, chicken or mutton) 200 gm. (salt-free), sugar, 40 gm. (Contains 1 to 2 gm. NaCl, 1500 cal.).

8 A.M. Bread 60 gm., lamb chop 50 gm., butter 10 gm., rice 100 gm., sugar 40 gm.

12 NOON. Bread 60 gm., roast beef 100 gm., butter 20 gm., beans 150 gm.

5 P.M. Bread 80 gm., butter 20 gm., chicken 50 gm.

TABLE XIV

DIET 2. LOW PROTEIN

| FOOD | PROTEIN, 25 GM. NO SALT IN FOOD OR ON TRAY | | | CALORIES, 1200 WEIGHT IN GM. | | | |
|---|---|---|---|---|---|---|---|
| | BREAKFAST | DINNER. | SUPPER | PROTEIN | CARBOHYDRATE | FAT | CALORIES |
| Grapefruit or .............. | 100 | | | | 5.0 | | 20.0 |
| Oranges, peaches, strawberries | 100 | | | | 10.0 | | 40.0 |
| Cream of Wheat or ......... | 20 | | | 2.2 | 15.2 | 2.2 | 72.0 |
| Corn Flakes ............... | 20 | | | 1.0 | 16.2 | .3 | 72.0 |
| Bread ..................... | 20 | 20 | 20 | 5.2 | 29.8 | .6 | 146.0 |
| Butter .................... | 10 | 10 | 10 | | | 25.0 | 225.0 |
| Cream ..................... | 60 | | | 2.0 | 2.0 | 12.0 | 120.0 |
| Vegetables, 5% group or | | 300 | 300 | 10.0 | 30.0 | | 160.0 |
| Vegetables, 10% group ...... | | 300 | 300 | 10.0 | 60.0 | | 280.0 |
| Sugar ..................... | 10 | 10 | 10 | | 28.3 | | 113.4 |
| Rice (uncooked weight) ..... | | 40 | | 3.2 | 31.6 | .1 | 140.1 |
| Potato .................... | | | 90 | 3.0 | 18.0 | | 90.0 |
| Canned pineapple .......... | | 100 | | .4 | 36.0 | .7 | 153.0 |
| Canned peaches or pears .... | | | 100 | .7 | 10.0 | .1 | 47.0 |
| | | | | 25.5 | 206.9 | 38.8 | 1278.8 |

TABLE XV

DIET 2. MEDIUM PROTEIN

| FOOD | PROTEIN, 35 GM. NO SALT IN FOOD OR ON TRAY | | | CALORIES, 1800. WEIGHT IN GM. | | | |
|---|---|---|---|---|---|---|---|
| | BREAKFAST | LUNCH | DINNER. | PROTEIN | CARBOHYDRATE | FAT | CALORIES |
| Grapefruit or | 100 | | | | 5.0 | | 20.0 |
| Oranges, peaches, strawberries | 100 | | | | 10.0 | | 40.0 |
| Cream of Wheat or — | 20 | | | | 15.2 | .2 | 72.0 |
| Corn Flakes ............... | 20 | | | 1.0 | 16.2 | .3 | 72.0 |
| Bread ..................... | 20 | 20 | 20 | 5.2 | 29.8 | .6 | 146.0 |
| Butter .................... | 20 | 20 | 20 | | | 50.0 | 450.0 |
| Cream ..................... | 45 | | 45 | 3.0 | 3.0 | 18.0 | 180.0 |
| Sugar ..................... | 10 | 10 | 10 | | 28.3 | | 113.4 |
| Egg ....................... | | 1 egg | | 6.0 | | 6.0 | 75.0 |
| Rice (dry weight) .......... | | 40 | | 3.2 | 31.6 | .1 | 140.1 |
| Potato .................... | | | 90 | 3.0 | 18.0 | | 90.0 |
| Meat (cooked) .............. | | | 30 | 8.0 | | 5.0 | 75.0 |
| Vegetables, 5% group or — | | 150 | 150 | 5.0 | 15.0 | | 80.0 |
| Vegetables, 10% group ...... | | 150 | 150 | 5.0 | 30.0 | | 140.0 |
| Canned pineapple .......... | | | 100 | .4 | 36.0 | .7 | 153.0 |
| Canned peaches or pears ..... | | 100 | | .7 | 10.0 | .1 | 47.0 |
| Olive Oil (on salad) ........ | | 15 | 15 | | | 30.0 | 270.0 |
| | | | | 35.5 | 191.9 | 110.7 | 1823.7 |

TABLE XVI

DIET 2. HIGH PROTEIN

| FOOD | PROTEIN 50 GM. NO SALT IN FOOD OR ON TRAY | | | CALORIES, 2400 WEIGHT IN GM. | | | |
|---|---|---|---|---|---|---|---|
| | BREAK-FAST | LUNCH | DINNER | PROTEIN | CARBO-HYDRATE | FAT | CALORIES |
| Grapefruit or | 100 | 100 | | 10.0 | 10.0 | | 40.0 |
| Orange, peach, strawberries .. | 100 | | | | 10.0 | | 40.0 |
| Cream of Wheat or | 30 | | | 3.3 | 22.8 | .4 | 108.0 |
| Corn Flakes ............... | 30 | | | 1.5 | 24.3 | .4 | 108.0 |
| Bread ..................... | 30 | 30 | 30 | 7.8 | 44.7 | 1.0 | 219.0 |
| Butter .................... | 15 | 30 | 30 | | | 62.5 | 562.5 |
| Cream ..................... | 60 | | 60 | 4.0 | 4.0 | 24.0 | 240.0 |
| Sugar ..................... | 10 | 10 | 10 | | 28.3 | | 113.2 |
| Stewed Prunes or fruit ...... | 120 | | | 2.4 | 83.1 | | 342.0 |
| Egg ....................... | | | 1 egg | 6.0 | | 6.0 | 75.0 |
| Rice (dry weight) .......... | | 50.0 | | 4.0 | 39.5 | .1 | 175.0 |
| Potato .................... | | | 90 | 3.0 | 18.0 | | 90.0 |
| Meat (cooked) ............ | | 60.0 | | 16.0 | | 10.0 | 154.0 |
| Canned fruit, peaches etc .... | | | 100 | .7 | 10.0 | .1 | 47.0 |
| Vegetables, 5% group or | | 150 | 150 | 5.0 | 15.0 | | 80.0 |
| Vegetables, 10% group ...... | | 150 | 150 | 5.0 | 30.0 | | 140.0 |
| Olive Oil (on salad) ........ | | 15 | 15 | | | 30.0 | 270.0 |
| | | | | 50.4 | 290.4 | 134.1 | 2570.1 |

Diet 3. Mosenthal Renal function test diet:

All foods from diet kitchen to be salt free, salt for each meal will be furnished in weighed amounts.

All foods or fluids not taken must be weighed or measured after each meal and charted. Allow no food or fluid excepting at meal times.

Breakfast, 8 A.M. 100 gm. oatmeal, ½ tsp. sugar.
30 c.c. milk, 60 gm. bread, 2 sl.
20 gm. butter.
160 c.c. coffee.
1 tsp. sugar } (200 c.c.).
40 c.c. milk.

Dinner, 12 NOON 180 c.c. meat soup.
100 gm. beefsteak.
130 gm. potatoes, (boiled, mashed or baked).
Green vegetables as desired.
60 gm. bread (2 slices).
20 gm. butter.
180 c.c. tea.
1 tsp. sugar } (200 c.c.).
20 c.c. milk.
250 c.c. water.
110 gm. tapioca or rice pudding.

| | |
|---|---|
| Supper, 5 P.M. | 2 eggs (cooked any way). |
| | 60 gm. bread (2 slices). |
| | 20 gm. butter. |
| | 180 c.c. tea. |
| | 1 tsp. sugar (200 c.c.). |
| | 20 c.c. milk. |
| | 1 portion stewed fruit or fresh fruit. |
| | 300 c.c. water. |

Eight A.M. No food or fluid is to be given during the night or until 8 o'clock next morning (after voiding) when the regular diet is resumed. Patient is to empty bladder at 8 A.M. and at the end of each period as indicated below. Specimens are to be collected for the following periods in properly labeled bottles: 8 A.M.-10 A.M., 10 A.M.-12 noon, 12 noon-2 P.M., 2 P.M.,-4 P.M., 4 P.M.-6 P.M., 6 P.M.-8 P.M., 8 P.M.-8 A.M.

**Basic Diets.**—(In nephritis, arteriosclerosis and acidosis states generally.)

Sansum, Blatherwick and Smith have shown that certain foods produce, after ingestion, acidity in the blood while others produce alkalinity. They found that by feeding the basic diets to patients with hypertension with or without nephritis they brought about a reduction of the urinary acidity and much clinical improvement. The following tables taken from their report are self-explanatory.

ACIDITY OF CERTAIN FOODS

| | |
|---|---|
| Bread, White | 2.7 |
| Bread, whole wheat | 3.0 |
| Corn, sweet, dried | 5.95 |
| Crackers | 7.81 |
| Cranberries | * |
| Eggs | 11.10 |
| Egg white | 5.24 |
| Egg yolk | 26.69 |
| Fish, haddock | 16.07 |
| Fish, pike | 11.81 |
| Meat, beef, lean | 13.91 |
| Meat, chicken | 17.01 |
| Meat, frog | 10.36 |
| Meat, pork, lean | 11.87 |
| Meat, rabbit | 14.80 |
| Meat, veal | 13.52 |
| Oysters | 30.00 |
| Oatmeal | 12.93 |
| Peanuts | 3.9 |
| Prunes, plums | * |
| Rice | 8.1 |

*The ash of these foods is alkaline, but because of contained substances which form hippuric acid in the body, they increase the acidity of the urine.

### Alkali-Producing Foods

| | |
|---|---|
| Almonds | 12.38 |
| Apples | 3.76 |
| Asparagus | .81 |
| Bananas | 5.56 |
| Beans, dried | 23.87 |
| Beans, lima, dried | 41.65 |
| Beets | 10.86 |
| Cabbage | 4.34 |
| Carrots | 10.82 |
| Cauliflower | 5.33 |
| Celery | 7.78 |
| Chestnuts | 7.42 |
| Currants, dried | 5.97 |
| Lemons | 5.45 |
| Lettuce | 7.37 |
| Milk, cow's | 2.37 |
| Muskmelon | 7.47 |
| Oranges | 5.61 |
| Peaches | 5.04 |
| Peas, dried | 7.07 |
| Potatoes | 7.19 |
| Radishes | 2.87 |
| Raisins | 23.68 |
| Turnips | 2.68 |

## A Basic (Alkaline) Diet (as Served)

*Breakfast*

Baked Apple with Cream
Bacon
½ Slice Toast Jelly Butter
1 Glass Orange Juice 1 Glass Milk

*Lunch*

Baked Stuffed Potato Beets in Cream
Combination Salad
½ slice Bread Butter Olives
Iced Cantaloupe
1 Glass Orange Juice 1 Glass Milk

*Dinner*

Cream of Spinach Soup
Escalloped Potatoes Buttered Peas and Carrots
½ slice Bread Butter Olives
California Fruit Salad
Apricot Ice Cream
1 Glass Orange Juice Nuts Raisins

### E. Diets for Cardiac Decompensation

Fluids are to be restricted to 1½ quarts in twenty-four hours. They are to be taken between meals and sipped slowly.

Salt: Quantity to be designated by physician; in any case in limited quantity. No condiments.

Meals should be uniform in quantity, at definite intervals. They may consist of: Milk, eggs, rare meat, poultry, fish; well-baked bread and rolls; well-cooked potato, spinach, asparagus, cauliflower and other green vegetables (all cooked); stewed fruits (with very little sugar); custards, junket, blanc mange, tapioca, ice cream (not rich).

The number of calories should be dictated by the physician, to be worked out by the dietitian. Starches, sugar and fats, (gravies, etc., fried foods) are to be greatly restricted or entirely avoided.

The following diet is an example of severe restrictions: All foods to be salt free. Feed every 2½ hours—6 feedings per day (8:00 A.M.,10:30 A.M., 1:00 P.M., 3:30 P.M., 6:00 P.M., 8:30 P.M.). Give 4 oz. water every 2½ hours—½ hour before feeding time. Four oz. junket (80 calories), 2 oz. scraped beef (122 calories), 2 coddled eggs, (150 calories), 6 oz. chicken broth with rice, 6 oz. custard (251 calories), 4 oz. ice cream, 1 sl. toast ½ inch thick with 1 sq. (13 gm.) butter (150 calories), 1 sl. milk toast with 4 oz. milk and ½ sq. butter (180 calories).

*Diet 2. Karell Diet:*

Salt free. Suitable for some cardiac decompensation cases.

For first 5 to 7 days (8:00 A.M., 4:00 P.M., 8:00 P.M.) 200 c.c. milk. No other fluids.

Eighth Day: Milk as above; 10:00 A.M., 1 soft boiled egg; 6:00 P.M., 2 pieces dry toast.

Ninth Day: Milk as above; 10:00 A.M., 1 soft cooked egg, 2 pieces dry toast; 6:00 P.M., 1 egg and 2 pieces dry toast.

Tenth Day: Milk as above; 12:00 noon, chopped meat, rice boiled in milk, vegetables; 6:00 P.M., 1 soft cooked egg.

Eleventh and Twelfth Days: Same as on tenth day. All foods to be salt free. Gradually increase diet further when the heart is practically compensated. All meats and vegetables added at first should be chopped.

*Diet 3.*

Smith, Gibson and Ross have devised a diet for use in cardiac failure which has many advantages over the diets now in use. It has been used by them in over fifty patients in whom the diet alone effected an elimina-

tion of the excess fluids. The Karell diet has obvious disadvantages: it provides insufficient energy and has too high a fluid content for its caloric value. The diet of Smith, Gibson and Ross depends for its effectiveness upon a low salt content, and easily available energy in the form of sugars and other simple carbohydrates. The employment of substances which have a low sodium chloride and a high potassium and calcium content, such as potato and banana, is in accord with the known results of calcium therapy in edema referred to elsewhere in this book (in the chapter on Drugs). The employment of large amounts of simple sugars and starches not only provides energy in an early assimilable form for these patients, but is in alignment with the work of Goulston, Carter and Edmunds and Cooper who found great improvement in cardiac failure simply from the introduction of glucose, sucrose or other simple sugars into the patient's organism. Edmunds and Cooper, for instance, found that in circulatory failure in experimental animals, after the usual cardiac stimulants had had very little effect that the introduction of 10 per cent glucose in the vein was followed by marked improvement in the blood pressure and heartbeat. The diet of Smith, Gibson, and Ross has an energy value of 2100 calories and provides 44 gm. of protein, 110 gm. of fat, and 222 gm. of carbohydrate.

Details of the diet are as follows:

*Meals*

| Breakfast | Gm. | |
|---|---|---|
| Milk | 100 | ½ cup |
| Cream | 66 | ¼ cup |
| Cereal (cooked) | 120 | ½ cup |
| Sucrose | 10 | 3 teaspoonfuls |
| Glucose | 10 | 6 teaspoonfuls |
| Dextrin-maltose | 10 | |
| Dinner | | |
| Cream | 132 | ½ cup |
| Soup-Potato | 50 | ¼ cup |
| Butter | 10 | 2 teaspoonfuls |
| Ice Cream | 100 | ½ cup |
| or | | |
| Junket | | ½ cup |
| Milk | 100 | ½ cup |
| Water | 100 | ½ cup |
| or | | |
| Crushed ice | 100 | 1 cup |

| | | |
|---|---|---|
| Supper | | |
| Cream | 66 | ¼ cup |
| Soup-Milk | 100 | ½ cup |
| Spinach | 50 | ¼ cup |
| Butter | 10 | 2 teaspoonfuls |
| Egg | 50 | 1 egg |
| Custard-Milk | 100 | ½ cup |
| Lactose | 10 | 3 teaspoonfuls |
| Glucose | 10 | 3 teaspoonfuls |

*Lunches*

| | | |
|---|---|---|
| 9 A.M. | | |
| Water or | 100 | ½ cup |
| Crushed ice | 100 | 1 cup |
| 10 A.M. | | |
| Orange juice | 150 | ¾ cup |
| Lemon juice | 5 | 1 teaspoonful |
| Sucrose | 10 | 3 teaspoonfuls |
| Glucose | 20 | 6 teaspoonfuls |
| 3 P.M. | | |
| Milk | 100 | ½ cup |
| Cream | 66 | ¼ cup |
| Flavoring | | |
| Dextrin-maltose | 12 | 4 teaspoonfuls |
| Sucrose | 5 | 1 teaspoonful |
| 4 P.M. | | |
| Water or | 100 | ½ cup |
| Crushed ice | 100 | 1 cup |
| 7 P.M. | | |
| Milk | 150 | ¾ cup |
| Dextrin-maltose | 10 | 3 teaspoonfuls |
| or candy | | 1 stick |

## F. Diet in Fevers—Particularly Typhoid Fever

Graves, the Dublin clinician, expressed the hope that there would be engraved upon his tombstone the words—"He fed fevers." Clinical opinion, in the interim between his day and ours, has veered to his way of thinking. The only common infectious disease in which, however, feeding is a serious problem is typhoid; here the duration of the disease is sufficiently long that considerable nutritional disturbance will occur unless the patient gets enough food. Up to 1910 it was generally the habit of clinicians to feed their typhoid patients so meagerly that they lost from ⅕ to ¼ of their body weight. Due to the work of many men—

Coleman, Miller, Carter and others—this habit has largely been changed in this country, and under a more liberal dietary the patient comes to his convalescence with hardly any loss of weight and feeling much better and stronger.

There have been done enough metabolism experiments in typhoid fever to enable us to place our feeding upon a reasonably sound basis. These experiments hold good in other prolonged hyperpyrexic states and may be considered in that light.

The findings may be expressed, somewhat tersely and dogmatically, as follows:

*The caloric requirements of a man with fever are a little higher than his normal caloric requirements.* His basal metabolism is a little higher and it has been found possible to maintain a patient at a level weight and in nitrogenous equilibrium by feeding 40 to 50 per cent above the normal caloric requirement. The fear of giving sufficient food in earlier days was that it would not be metabolized when the body was at high temperatures. The foods will be as well metabolized in fever as under normal circumstances provided they yield energy readily. A man weighing 150 pounds, and requiring 2400 C. at rest, will with high temperature require 4000 to 5000 C. a day.

*The digestion of the patient with fever is quite as efficient as the normal individual's.* This was another old bugaboo. It is true that the appetite is sluggish and the mouth dry, but when food is ingested it is digested quite effectively.

*The protein requirement of the body under fever conditions is probably higher than under normal conditions.* Coleman and Shaffer put the figure at between 80 and 120 gm. for a person of about 150 pounds weight.

This, as will be seen, is much higher than the protein requirement announced by Chittenden for normal individuals; but it has not been possible, for obvious reasons, to determine the figure for sick patients with as great exactness as Chittenden was able to, under conditions which were practically those of human animal experimentation. The figures of Coleman and Shaffer represent deductions based upon the calculated loss of protein in fever under conditions of unbalanced caloric requirements. In other words with the patient upon an ordinary fever diet, with calories far below its needs, such protein loss occurs. Now we have seen above that *carbohydrates are the great sparers of protein.* Carbohydrates too are much more easily borne than fat in fevers; more easily digested, apparently more completely absorbed. Therefore we arrive at our last conclusion.

*The greatest amount of our caloric intake in fever should be in the form of carbohydrates.*

With these conclusions in mind let us glance at the older idea of diet in typhoid fever. It consisted mostly in milk. Now calculating 6 ounces of milk every 4 hours would equal 36 ounces of milk which amounts to 720 calories; but it would contain 40 grams of protein. To obtain anything approaching adequate calories—say 3000—would require over 2 gallons of milk a day and would yield 170 grams of protein.

But say we add 2 drams of milk sugar to every 6 ounces of milk; this would add nearly 200 calories to the six daily milk feedings. Let us add also 2 drams of cream to each glass and we have 100 more calories a day. We have increased our calories to over 1000 and have not increased the bulk of our food, to any appreciable degree, nor its digestibility at all. Now to these six milk feedings let us add a soft boiled egg twice a day. A piece of toast with some butter, a glass of sweetened lemonade, a cup of coffee with cream and sugar, a cup of cocoa, a plate of ice cream. Surely no one can object to these articles as being too difficult to digest even for a fever patient. And they avoid the monotony of a strict milk diet and furnish a caloric intake adequate to the patient's needs.

Under favorable circumstances mashed potatoes, cream soups, custards, junket, jellies and oatmeal may be given typhoid patients. Subjoined are some purely milk diets and more liberal typhoid diets.

EXAMPLES OF MILK DIETS IN TYPHOID (AFTER COLEMAN)

| | CALORIES |
|---|---|
| *1000 calories per day—* | |
| Milk, 1000 c.c. (1 qt.) | 700 |
| Cream, 50 c.c. (1⅔ oz.) | 100 |
| Lactose, 50 gm. (1⅔ oz.) | 200 |
| This furnishes 8 feedings, each containing: | |
| Milk, 120 c.c. (4 oz.) | 80 |
| Cream, 8 gm. (2 dr.) | 15 |
| Lactose, 6 gm. (1½ dr.) | 24 |
| *2000 calories per day—* | |
| Milk, 1500 c.c. (1½ qt.) | 1000 |
| Cream, 240 c.c. (8 oz.) | 500 |
| Lactose, 125 gm. (4 oz.) | 500 |
| This furnishes 7 feedings, each containing: | |
| Milk, 210 c.c. (7 oz.) | 140 |
| Cream, 30 c.c. (1 oz.) | 60 |
| Lactose, 18 gm. (4½ dr.) | 72 |

*3000 calories per day—*

| | |
|---|---|
| Milk, 1500 c.c. (1½ qt.) | 1000 |
| Cream, 480 c.c. (1 pt.) | 2000 |
| Lactose, 250 gm. (8 oz.) | 1000 |

This furnishes 8 feedings, each containing:

| | |
|---|---|
| Milk, 180 c.c. (6 oz.) | 120 |
| Cream, 60 c.c. (2 oz.) | 120 |
| Lactose, 30 gm. (1 oz.) | 120 |

Example of Liberal Feeding in Typhoid Fever

| | | CALORIES |
|---|---|---|
| 6 A.M. | Milk 4 oz. with cream 2 oz. | 195 |
| 8 A.M. | Strained gruel, cream 2½ oz. 100 gm. | 175 |
| | 1 soft cooked egg | 60 |
| | Toast 1 slice, well moistened | 73 |
| | Butter 10 gm. | 72 |
| | Cocoa 6 oz. | 155 |
| 10 A.M. | Milk 4 oz. with cream 2 oz. | 195 |
| 12 M. | Cream soup 200 c.c. | 250 |
| | Toast 1 slice | 73 |
| | Butter 10 gm. | 72 |
| | Gelatine 60 gm. | 40 |
| | Cocoa 6 oz. | 155 |
| 2 P.M. | Eggnog 1 egg, 4 oz. milk | 195 |
| 4 P.M. | Junket or soft pudding 4 oz. | 130 |
| 6 P.M. | Strained gruel, cream 2 oz. 100 gm. | 175 |
| | Toast 1 slice | 73 |
| | Butter 10 gm. | 72 |
| | 1 soft cooked egg | 60 |
| | Custard 60 gm. | 80 |
| | Cocoa 6 oz. | 155 |
| 8 P.M. | Milk 4 oz. with cream 2 oz. | 195 |
| 12 P.M. | Strained gruel 100 gms, cream 2½ oz. | 175 |
| | Milk 4 oz. with cream 2 oz. | 195 |
| 4 A.M. | Milk 4 oz. with cream 2 oz. | 195 |
| | Daily Total | 3180 |

## G. Hyperalimentation Diets

**1. Tuberculosis.**—It is generally understood and practiced that the patient with tuberculosis should be overfed. In reviewing the literature the only careful records of experimental nutrition studies in tuberculosis which I find are those of McCann's. After studying ten tuberculous patients in the metabolism laboratory of Bellevue Hospital, McCann concludes that nitrogenous equilibrium may be maintained in tuberculosis on sixty to ninety grams of protein per day in the patient of average weight. He found that a large amount of carbohydrate in the diet helped to reduce the nitrogen waste; this, of course, simply carries out the idea which we found to be true in the acute fevers. So far as total caloric requirements are concerned McCann put the figure for pulmonary tuberculosis at twenty-five hundred to three thousand calories per day.

While no doubt these experiments were most carefully done, I trust that the conclusions will not be taken too seriously by young practitioners. The idea of hyperalimentation in tuberculosis has been so well grounded clinically and has been so long productive of good results that there is no reason to cast about for a modification of it. The idea of reducing a tuberculous patient's diet to the lowest possible minimum would appear to be unnecessarily fraught with danger. We know that wasting is a prime symptom of this disease and we know we must replace the tissue loss. "Fattening" cures are, however, deprecated by most tuberculosis experts. The diet in tuberculosis depends upon circumstances. Some patients have digestive symptoms as their outstanding complaint—they are nauseated at the sight of food, or have complete loss of appetite. Such patients will have to be fed lightly at first and encouraged to eat more as time goes on. In the incipient cases there may be no loss of weight and little fever, and "fattening" is not in order for them.

But most tubercular patients will do well on a hyperalimentary regime for some time after beginning treatment. They should be allowed to eat three large meals a day, at regular hours and have whatever their desires dictate; upon the principle that what one relishes nourishes. Too much interference at this stage is bad. Besides that they should have in the middle of the morning, the middle of the afternoon and at bedtime a concentrated, easily digested, caloric high, protein high snack of some kind. The best of these is a glass of half milk and half cream, or an eggnog. But for variety's sake a cup of cocoa, a plate of ice cream, a glass of sweet lemonade or orange juice, or a chopped meat or cheese sandwich may be allowed. The patient should be reminded that "an appetite is a luxury, not a necessity"; he can eat without it. And the phrase, "In the middle of the morning, the middle of the afternoon and at bedtime" should be often on the physician's lips.

2. **Hyperthyroidism—Graves' Disease.**—We know that in this condition the basal metabolism may be raised higher than in any other disease. This must mean extra food combustion. As a matter of fact the patients are usually emaciated and very frequently complain of a voracious appetite. These are certainly indications for a diet of high caloric content. One of my patients after losing weight rapidly finally reached the point of 113 pounds; then she was kept in bed day and night with an intake of over 5000 calories a day, and did not gain a pound during the entire time; nor did she lose.

The diet then should be sufficient to keep the patient at least in weight equilibrium. If gain occurs it is usually a sign of progress.

As to the character of the food it does not seem important. Bram is very insistent, in his book on the "Nonsurgical Treatment of Exophthalmic Goiter" (C. V. Mosby Co.) that animal or flesh food should be largely eliminated from the hyperthyroid patient's diet. I have been entirely unconvinced that he has any good reason for this. In fact, on experimental grounds, knowing how readily the amount of blood sugar is increased in these patients on feeding glucose it would seem that they do not metabolize the carbohydrates very readily—and that their protein content should be high.

In actual practice, however, all kinds of food seem to be used by them without harm. My instructions to them are much like my instructions to my tuberculosis patients and are as follows:

Eat your three regular meals at the usual time. Eat what you like. Eat as much or even a little more than you like.

In addition at 10 A.M., 3 P.M. and before retiring eat one of the items on this list:

A glass of milk.
A glass of half milk and half cream.
A plate of ice cream.
A cup of chocolate.
A cheese or meat sandwich.
An eggnog.
A glass of malted milk.

Drink no water unless it is distilled.

3. **Visceroptosis.**—Visceroptosis is another disease in which extra nourishment is required. The circumstances are sometimes quite different with it, though, than with the previous conditions because the mechanics of digestion may be much impaired. The stomach may be very low while the pylorus is held high and thus a mechanical impediment to early emptying is present. The meals then should be dry, small in amount and frequent. My instructions to such patients are as follows:

Your meals should be:

1. Small in amount, at each meal.
2. Nutritious.
3. Easily digested.
4. Dry in character.

You should not drink much water or other fluid at meal time.

It is very important for you to lie down for half to three-quarters of an hour after each meal, lying on your back or left side.

You should have five meals a day as each one is small and you need extra nourishment.

The best foods for you are broiled tender meats, such as chicken, turkey, guinea fowl, steak, roast beef, bacon, lamb chops, oysters and fish. Avoid veal, broiled ham, pork and fried meat generally as being tough and difficult to digest. Vegetables in any form except fried; soups, salad and light desserts are all good. Have your bread toasted. Avoid spices, pickles, soggy puddings, tough articles, uncooked articles except oranges and grape fruit. (Other fruits should be cooked.) Drink a glass of cool cream in the middle of the morning, middle of the afternoon and before going to bed.

### H. Diet in Blood Diseases

**I. Diet in Pernicious Anemia.**—The Minot and Murphy Daily Allowance:

1. From 120 to 240 gm., and sometimes even more, of cooked calf's liver or beef liver. An equal quantity of lamb's kidneys was substituted occasionally.

2. One hundred and twenty grams of beef or mutton muscle meat.

3. Not less than 300 gm. of vegetables, especially lettuce and spinach, containing from 1 to 10 per cent of carbohydrate.

4. From 250 to 500 gm. of fruit.

5. About 40 gm. of fat derived from butter and cream, allowed in order to make the food attractive. Animal fats and oils were excluded as far as possible.

6. If desired, an egg and 240 gm. of milk.

7. In addition, dry and crusty bread, potato and cereals, in order to allow a total intake of between 2,000 and 3,000 calories, usually composed of about 340 gm. of carbohydrate, 135 gm. of protein, and not more than 70 gm. of fat. Grossly sweet foods are not allowed, but sugar is permitted very sparingly.

A daily menu is suggested below:

*Breakfast*

| | Approximate weight in grams |
|---|---|
| Liver or kidneys, broiled | 100 |
| Oatmeal, 2 heaping Tbs. cooked or dry meal | 18 |
| Milk, 3 tablespoons | 45 |
| Sugar, 2 level teaspoons | 10 |
| Toast, 3 slices (each slice 4 x 2 x ¼ inch) | 30 |
| Butter, 1 level teaspoon or a piece 1 x 1 x ½ inch | 5 |
| *Fruit, choice of:* | |
| a. Oranges, average size | 120 |
| b. Strawberries, 5½ tablespoons | 180 |
| c. Grapefruit, one-half of one very large one | 200 |
| d. Peach, 1 large one | 120 |

*Dinner*

| | |
|---|---|
| Beefsteak or roast, trimmed of fat; very large serving | 120 |
| Vegetables, freshly cooked, as spinach, string beans, cabbage, tomatoes, etc. Two average portions, or 5 to 6 tbsps. | 250 |
| Potato, baked, medium sized | 130 |
| Bread, 2 slices (each slice 3 x 4½) | 70 |
| Salad: Pineapple 2½ slices of size in cans | 140 |
| Lettuce, big helping | 75 |
| Pudding made of: | |
| a. Gelatine, 1 t. dry weight | 2 |
| b. Rice, boiled, 2 heaping T. | 160 |
| c. Raisins, 20 large ones | 50 |
| d. Milk, 2 tablespoons | 30 |
| Fruits may be put into such desserts and raisins eaten separately. | |

*Supper*

| | |
|---|---|
| *Liver Soup, composed of:* | |
| a. Liver, minced | 100 |
| b. Milk, 1 tumblerful | 220 |
| c. Flour (white 1 teaspoonful) | 4 |
| d. Butter, 1 rounded teaspoonful or piece 1 x 1 x ⅞ in. | 10 |
| Lamb, roast, without fatty parts, 2 small pieces | 60 |
| Macaroni, boiled, 3 tablespoons, or | 150 |
| Potato, small one, or rice, 1 heaping tbsp. | 80 |
| Vegetables, fresh, 2 average portions 5 to 8 T. | 250 |
| Uneeda Biscuits or Triscuits, 4 | 25 |
| Butter, 1 level t. or a piece 1 x 1 x ½ in. | 5 |
| Choice of: | |
| a. Strawberries, 7 tbsp. | 225 |
| b. Orange, large one | 150 |
| c. Apricots, or prunes, stewed, 2 tbsp. | 100 |
| b. Sugar, 2 heaping teaspoonfuls | 20 |

The *Journal of the American Medical Association* furnishes the following recipes for cooking liver from French and English sources. In these countries liver is a much more popular food than it is in the United States.

*French ways of cooking liver:*

1 pound of liver.
1 slice of bread grated—this means grated, not crumbled.
1 tablespoon chopped parsley.
½ teaspoon salt.
¼ teaspoon pepper.
A very thin slice of ham.

Wash the liver well and cut into thin slices; put into casserole; sprinkle the bread crumbs over it, then the parsley, pepper and salt. Cut the ham into strips and lay it on top, then pour in one teacupful of cold water. Bake in oven for half an hour.

*Another French recipe:*

1 pound calf's liver.
3 tablespoons grated bread crumbs.
4 large mushrooms, chopped.
1 medium-sized onion, finely chopped.
2 sprigs parsley, finely chopped.
½ teaspoon salt, pinch of pepper.

Cut the liver into slices half an inch thick, and sprinkle each slice with the mixture of bread crumbs, mushrooms and seasonings; put in a casserole, pour over it one-half pint of cold water or good soup stock and bake in a slow oven for three-quarters of an hour.

*English recipe:*

Boil 2 pounds of liver until it is firm enough to chop easily; then mince it rather finely with a little bacon. Chop a Spanish onion and fry slowly in butter or bacon fat—just long enought to make it soft; then add the liver, season very slightly with salt and pepper and cook slowly, stirring continually for ten or twelve minutes. Then add a cup of soup and a tablespoon of chopped parsley and a very little Yorkshire relish (this last item may be omitted). Cover closely and let simmer gently about an hour. Serve on toast.

*Another English recipe:*

1 calf's liver.
1 bunch savory herbs, including parsley.
2 chopped shalots (onions may be used instead, but they should be parboiled before chopping)
1 tablespoon flour.
1 tablespoon lemon juice.
¼ pint water.
Pepper and salt.

Cut the liver into slices, dip in flour, and fry in butter until a light gold color. Take out of pan and keep hot.

Mince the herbs very fine, put in frying pan, add a little more butter, add the remaining ingredients, simmer gently until the herbs are cooked, then pour over liver.

### I. Rectal Feeding—Nutrient Enemata

Under certain conditions it is desirable to withhold all food by mouth and endeavor to give nourishment to the patient by rectal absorption. This may occur in the pernicious vomiting of pregnancy, cancer of the stomach, esophageal disease, postoperative stomach cases, etc.

In planning nutritive enemata the following facts by Edsall should be taken into account.

1. The rectum will absorb only from 240 to 645 calories per day—$\frac{1}{10}$ to $\frac{1}{6}$ of the total requirements.

2. Carbohydrates of the three main classes of foodstuffs are best absorbed—$\frac{9}{10}$ of the total amount injected being taken up by the rectum.

3. Proteins must be predigested by artificial means—and even so only $\frac{1}{6}$ of the total amount injected is usually absorbed.

4. Fats are practically not absorbed by rectum at all.

5. Most salts and water are well absorbed.

6. Alcohol is well absorbed in a 2 per cent solution.

In planning a nutrient enema, then, glucose, normal salt solution, and weak brandy are the staples.

For a protein, skimmed milk is selected because it is a complete protein, and contains the proper amounts of phosphates and calcium. It should be pancreatized.

Nutrient enemata should not be injected into the rectum *en masse*, but allowed to drip in slowly by proctoclysis. By this method a very high amount of absorption is obtained.

Prescription for rectal feeding:

Mixture I. One ounce glucose, ½ ounce of brandy, 30 grains of sodium bicarbonate in 10 ounces of water. Warmed to temperature of 100° F.

Mixture II. Five ounces skimmed milk pancreatized. Warmed to temperature of 100° F.

| | | |
|---|---|---|
| Schedule: | 8 A.M. | Mixture I by protoclysis. |
| | 12 M. | Mixture II by protoclysis. |
| | 4 P.M. | Mixture I by protoclysis. |
| | 8 P.M. | Mixture II by protoclysis. |
| | 12 P.M. | Mixture I by protoclysis. |

## I. INFANT FEEDING

Written by Joseph B. Cowherd, M.D.

### 1. Breast Feeding

**Incidence and Importance of Breast Milk.**—Breast milk is the only ideal food for the infant. More children under one year of age die of intestinal diseases than of any other one cause. In the congested districts of our large cities the infant mortality among bottle fed babies is far greater than among those fed at the breast. Many statistics prove this fact. Dr. Holt reports that of 1,000 fatal cases of diarrheal diseases investigated by the Health Department of New York City in 1908 only 90 had been entirely breast-fed. Generally speaking, a breast-fed infant is healthier and singularly more resistant to disease.

Realizing this, we must impress upon the medical profession and instruct our future doctors, nurses, and welfare workers that an infant should be weaned only after all efforts at breast feeding have been proved futile.

**Composition and Chemistry of Human Milk.**—*Colostrum,* or the first milk secreted by the breast is, according to Czerny and Keller, the remains of the milk secreted into the breast during pregnancy from which certain elements have been absorbed, thereby differing essentially from that of established breast milk. It is of a deep lemon color and has a strong alkaline reaction. It is generally thought to be laxative and of aid in ridding the intestinal tract of meconium. This laxative action, however, is very mild. Its composition is given as fat 3.34 per cent, lactose 5.27 per cent, nitrogenous substances 3.07 per cent, salts 0.40 per cent, water 86.4 per cent.

**Bacteriology.**—Investigation has shown that breast milk (which is usually spoken of as being sterile) sometimes contains microorganisms,

chiefly the staphylococcus aureus. Infants take this milk and the bacteria seem to cause no pathologic disturbance. It is quite possible when this milk is taken by children suffering from digestive disturbances that it may produce a distinct pathologic condition. This, however, is rarely encountered. These organisms evidently enter from the outside and live in the larger ducts and tubules of the nipple. Infants nursing straight from the breast get their food directly transmitted and have little chance for contamination by any other organisms, if the nipple is properly cleansed before nursing.

**Established Breast Milk.**—Human milk resembles cow's milk, has no odor and is much sweeter, containing nearly twice as much sugar. The color varies from a bluish white to a rich yellow depending on the amount of cream it contains. Under the microscope will be seen many minute fat droplets held suspended in a permanent state of emulsion. An occasional epithelial cell may be present.

Its specific gravity averages between 1.030 and 1.032 but may have a range from 1.030 to 1.036.

The reaction of human milk is amphoteric, alkaline to litmus and acid to phenolphthalein. The reason for this is that milk contains phosphates which are acid as well as alkaline. The alkaline reaction is relatively stronger and the absolute amount of acidity is less than in cow's milk.

The 24 hours' amount of milk secreted by a healthy mother depends to a great extent on the needs of the infant, a stronger baby tending to produce more milk than a weaker one. The daily average as given by Holt is:

| | |
|---|---|
| 1 week to 4 weeks | 10 oz. to 26 oz. |
| 1 month to 3 months | 16 oz. to 34 oz. |
| 4 months to 8 months | 24 oz. to 40 oz. |

Mother's milk is composed of fat 4 per cent, lactose or milk sugar 7 per cent, protein 1.25 per cent, salts 0.20 per cent and water. The extractives and other (unknown) substances are of no consequence in infant feeding.

**Fat.**—The fat is in very fine state of emulsion which makes it easier for the digestive fluids to attack and digest. The percentage of fat varies in the different nursings from day to day. The amount is smallest at the beginning and steadily increases during the nursing, averaging from 3½ to 4 per cent. Mother's milk contains much less volatile fatty acids than cow's milk. To the larger amount of oleic acid is due the higher iodine value of mother's milk over cow's milk. The percentage of

fat remains fairly constant during the early months, diminishing during the later months of lactation. The only reliable way of obtaining the percentage is by the well-known Babcock test.

**Sugar.**—Milk sugar or lactose is identical with that in cow's milk. It is probably formed from the dextrose in the blood and varies the least of all the elements in mother's milk. It is twice as abundant in mother's milk, being about 7 per cent.

**Protein.**—There are two classes of protein bodies in milk, the soluble lactalbumin and globulin and the insoluble or casein. Human milk under the action of rennet does not coagulate uniformly and is precipitated with greater difficulty by acids, hence, the curds are not so large and in such coarse masses as the casein of cow's milk. The lactalbumin is twice as abundant as the casein and resembles the serum albumin of our blood. It contains the amino-acids in their most desirable forms and proportions. Of all albuminous material it is most easily digested, absorbed, and properly metabolized. Protein exists in mother's milk in the proportion of 1.25 per cent. The determination of the percentage of protein by clinical analysis is not satisfactory. An approximate percentage may be attained by a knowledge of the percentage of fat and the specific gravity. The specific gravity is increased by the proportion of protein and decreased by the proportion of fat. This only tells us whether the protein is high or low, which after all is the needed information.

**Salts.**—The average amount of ash in human milk is 0.21 per cent. The proportion of the different salts differs from day to day as they do in the different specimens of milk. They also differ during the stages of lactation decreasing towards the end of lactation as does protein. Table XVII shows the various salts in human milk to 100 parts of ash during the different stages of lactation.

Table XVII*

| | $CaO$ | $MgO$ | $P_2O_5$ | $Na_2O$ | $K_2O$ | |
|---|---|---|---|---|---|---|
| Colostrum ............ | 14.2 | 3.5 | 12.5 | 13.7 | 28.1 | 20.6 |
| Transition ............ | 17.0 | 2.4 | 16.9 | 10.9 | 30.8 | 22.9 |
| Mature .............. | 23.3 | 3.7 | 16.6 | 7.2 | 28.3 | 16.5 |
| Late .................. | 19.8 | 3.6 | 15.5 | 10.1 | 28.8 | 22.3 |

*Holt, Courtney, Fales, Am. Jour. Dis. Child., 1915, x.

Calcium decreases somewhat as lactation proceeds and is not increased by the feeding of calcium to the mother.

Phosphorus in mother's milk is in a different form from cow's milk, being ¾ organic combination and ¼ inorganic. As much of the phosphorus is in the casein, mother's milk contains less phosphorus than cow's milk.

Iron varies with the general state of health of the mother, depending, of course, on the amount of her hemoglobin.

**Ability to Nurse.**--The most successful age for nursing seems to be between twenty and thirty-five, but there are recorded cases where girls of 14 and women over 50 have successfully nursed their babies. There is, therefore, such a wide variance in the ability to nurse that no set rule should keep us from looking upon each mother as a possible source of a perfect milk supply.

Milk normally comes into the breast some time during the third day after delivery. The so-called rush of milk has been so often described that mothers become nervous and discouraged because of the lack of this sudden appearance, while it is just as normal for the milk to appear slowly, increasing in amount up to the tenth day. It seems to me in my practice that the mothers who have experienced a hard or prolonged labor are most likely to have the milk come gradually as well as later than the third day. In neither instance does this seem to portend either successful or unsuccessful nursing. Milk may appear as early as the second day and has been recorded as late as the sixth day.

Nursing frequently is discontinued on account of tender or fissured nipples. These many times are exquisitely painful, but if protected during nursing by the use of a nipple shield they usually heal in a very short time. The nipples should be cleansed before and after nursing with a solution of sodium borate, 10 to 20 grains to the ounce, and a bland, soothing ointment applied. If visible fissures are present the raw surface should be touched with a 2-10 per cent silver nitrate solution. The application of the silver should not be for any protracted length of time and never oftener than once a day, else the nipple will become so dry that further cracking may take place. Retracted nipples in which the nipple is dimpled and does not stand out from the breast is a frequent cause for mothers not nursing their infants. Much can be done for this condition in the prenatal care by pulling the nipples out, either by careful manipulation, the use of a breast pump, or by sucking, the object being to stimulate and develop the erectile tissue of the nipple. I should advise that only washing with sterile water or sodium borate solution and drying with absorbent cotton be used as a routine for the care of normal nipples. The persistent use of oil or ointment on normal nipples may cause them to become easily macerated when vigorous nursing is added. In the cases where the nipples are too sensitive for the infant to nurse, many times the breast pump will in a measure give relief to the mother and at the same time secure the milk which may be fed in a bottle to the infant.

On the part of the infant such conditions as harelip, cleft palate, tied tongue, and nasal obstruction from adenoids may interfere with the proper drainage of the breasts and cause nursing to be discontinued. The condition of adenoids and tied tongue can be very easily corrected, while in cleft palate cases the milk should be withdrawn and fed to the baby in order to give it as good a start as possible.

There seems to be an erroneous belief that if mother's milk is not entirely sufficient for her baby's needs it should not be mixed with artificial food and that unless she can nurse her baby for several months she should not nurse at all. Certainly, there is no time in an infant's life when breast milk, no matter how little it may be, is of greater value than to the newborn.

In deciding whether in a given case a mother is unable, on account of her own health, to nurse her baby, remember that nursing is a physiologic function and not a pathologic condition. Many mothers never have such good health or feel quite so well as when they are nursing their infants. Even if nursing proves to be a drainage on a mother's health it should at least be undertaken for the first two or three months, provided there exists in the mother no pathologic condition which might be lighted up. If the mother only feels tired and worn out, even though she may lose a little weight, this is a sacrifice she should make for her infant. Women many times believe themselves too nervous to nurse. This extreme nervousness wears off after mothers have become adjusted to their infants and thoroughly rested from their confinement. In fact, mother's milk many times is not in any way constant until lactation has proceeded for one month and they have again entered upon their normal mode of living.

**Nursing at the Beginning of Lactation.**—Just how soon a newborn infant should be put to the breast depends to a great extent on the condition of the mother. As has been intimated, the milk appears later in mothers who have experienced a hard confinement, therefore, it seems practical not to have the baby nurse as soon or as often in these cases until the flow is established. Nursing stimulates the flow of milk, but it is of more importance after the supply of milk has been established. It certainly is harmful to have a baby vigorously nursing a breast which as a rule is not intended to secrete milk until the third or fourth day. I have just as often known milk to appear at the end of seventy-two hours with practically no breast nursing. Take, for instance, the stillborn child; in this case there has been no breast nursing and the milk appears on the third or fourth day just the same. The nursing, then, during the first few days should be chiefly for the purpose of clearing out the milk ducts of colostrum and other debris, getting ready for

the regular institution of breast nursing. Mothers who have had an easy labor may justly have their babies brought to them sooner, say at the end of twelve hours. I find that waiting until the mother inquires about or asks to nurse her baby is a very fair criterion as to her present strength and an index to the character of her labor. After twenty-four hours, at the mother's request the nursing may be started at any time and during the first nursing day every six hours should be sufficient until the breast milk starts to flow, after which a four- and then a three-hour schedule may be instituted.

During the first three or four days there is a rapid loss in the infant's weight caused chiefly by the emptying of the bladder and bowels and by the lack of intake of sufficient amount of fluids. This is of no consequence and is considered in fact to be normal. The loss, however, can be lessened by the earlier administration of water which is necessary to flush out the kidneys and bowels and keep up the blood content in liquid while the digestive organs begin to function. A vigorous baby many times will begin to show signs of hunger at the end of twelve hours and should be given water in two to four dram doses every two to three hours, rapidly increasing to one ounce every two to four hours as the stomach accommodates itself in size. When plain water ceases to satisfy, a 5 per cent solution of milk sugar should be used until the breast milk appears. It seems that any routine giving of formulas while waiting for the establishment of breast milk is certainly not to be encouraged. During the first few days the intestinal tract still contains meconium and the intestinal secretions if present are in very small quantities. When infants are fed early it does not seem to prevent the initial loss in weight and in all probability the food is not digested. It is much better that the first food taken into the intestinal tract and assimilated be mother's milk until the intestinal tract has started to function normally, even though for a few days it should not be sufficient for the baby to gain. Cow's milk, unless boiled longer than is usually done in infant feeding, is not sterile and may produce an infection which at this age is extremely hard to correct and may even prove fatal to the baby.

It is rather a common occurrence for an infant on the third or fourth day to have a temperature ranging from 101 to 103 degrees. These children present no physical findings except temperature and loss of weight, and upon inquiring it is found that they have had little or no breast milk. This is called a starvation temperature and is quickly overcome by a colon flush and a dram of castor oil, followed immediately by food. If breast milk is not obtainable a formula will have to be given. (For formulae see chapter on Artificial Feeding.) If care is

used to give a sufficient amount of water and 5 per cent sugar solution when plain water ceases to satisfy, the number of starvation temperatures will be greatly reduced. The greatest therapeutic measure known during the first few days of life is the free administration of water, and when it cannot be taken by mouth, a normal salt solution must be given under the skin. It is an easy matter to give from 50 to 150 c.c. subcutaneously over the region of the chest in front and back. Many babies who do not nurse normally or who from other minor causes, not necessarily pathologic, do not thrive, die because they do not get enough water to supply their needs until their vital functions become better established.

It is not necessary to give a dose of castor oil soon after birth. Babies showing such symptoms as vomiting, drowsiness, or fever, should be given a dose.

**Daily Nursing Technic.**—(1) *Position of Infant.*—The proper position of a baby while at the breast is important because a baby not comfortable will present many symptoms which make mothers think their milk is not suitable. They should be lying on their side, well supported, with head elevated so that they can get air freely while nursing. Care should be taken to see that they are not smothered against the breast.

Although the stomach is nearly perpendicular at birth it rapidly assumes an oblique position from above downward, from left to right, and from behind forward; consequently babies nursed in a horizontal position have the air which is swallowed collect in the lower part of the stomach which is uppermost. This overdistention of the stomach causes distress and spitting up of food. To get rid of this air (not gas) the child should be nursed in installments, holding it over the shoulder after each five minutes of nursing to rid the stomach of air before filled to capacity. The baby should be made to nurse slowly at first because the flow is more abundant and vomiting may ensue if the milk is taken too rapidly. Ordinarily, one-half of the total nursing is taken during the first five minutes.

(2) *Time Required for Nursing.*—Where the milk supply is ample from fifteen to twenty minutes is sufficient time for the average baby to empty the breast. Some more vigorous infants can establish a better record, while weaker infants and a less abundant milk supply will take the full twenty minutes. If a baby wants to nurse longer than twenty-five minutes usually there is a deficient supply and symptoms of hunger will soon appear with a stationary, or loss of, weight. The amount of milk actually taken by infants at any single nursing is subject to a wide variance. The morning nursings are usually heavier than the afternoon and may vary from 6 ounces to 3 ounces. The total amount taken

in twenty-four hours is the important thing and this should be sufficient to satisfy and obtain normal growth.

*The Interval of Nursing.*—This should be three to four hours, and the infants may in a way decide this for themselves. Many babies have an abundant milk supply and take enough for their needs of growth in five feedings a day, nursing every four hours. They seem to need no more food and automatically put themselves on this schedule. The four-hour period is a boon to some mothers who wish a lot of freedom for household duties, and for absolutely normal babies is applicable, while it is certainly dangerous to make all babies adhere to this rule. Other infants with less abundant supply cannot be made to go four hours with any degree of happiness, while the weaker and premature infants, being able to take much less at a time, should not and cannot go four hours. It is only in special instances of premature infants that nursing should be allowed any oftener than three hours. The three-hour period is usually maintained until about the fifth or sixth month when the four-hour interval is instituted. No matter what schedule is chosen as suitable for the infant under consideration, it must be adhered to regularly. Babies must be awakened if necessary to keep an approximate schedule because regular nursing means regular appetite and regular emptying of the breasts, which in turn helps standardize the supply of breast milk. Only one night feeding between 10 P.M. and 6 A.M. is ever needed and this may be given at any time provided it is not closer than three hours to the preceding or following feeding. The night nursing is usually discontinued after the second or third month. Breasts should be alternately nursed from because in this way a steady production of milk is made more possible. Both breasts, however, may be used if by doing so a sufficient supply may be had, otherwise supplementary feeding should be given.

**Mother's Diet and Its Effect on Breast Milk.**—It is most imperative for mothers to be instructed that they are to eat as normal a diet as they had eaten before pregnancy and motherhood. There is no need for any radical change in diet as is so often thought because the mother must take food sufficient for two. The same kind of diet increased in quantity usually meets the requirements. In addition it is best for the mother to take daily an extra quart of nutritious liquid, preferably milk.

The old theory that nursing mothers should not eat certain vegetables and acid fruits is no longer given credence. The only indication for taking certain articles from her diet is when a particular thing repeatedly disagrees. Often it will disagree once and not again, due to fatigue or worry. We repeatedly see mothers whose milk is sufficient

in quantity but not rich enough for a baby's nutritional needs, due entirely to a too restricted diet. It is a far safer rule to allow mothers to eat everything they can well digest rather than be put on a restricted diet.

Experience, however, has taught us that some classes of food disturb so many mothers that it may be well to omit them. These are the very highly seasoned food, condiments, vinegar pickles, pastries, and fried foods.

Milk serves both the purpose of enriching the quality and the quantity of the mother's milk. It is doubtful whether the use of more than a quart is of any advantage; in fact an extra quantity adds to the usual constipation and may even upset the mother's digestion.

The use of malt beverages does seem for a short while to increase the quantity of milk, but if persistently used upsets the digestion of the mother, producing rather typical symptoms of biliousness.

Little can be done to improve breast milk that is poor on a properly balanced diet. In a mother who is undernourished the quality of her milk can be greatly improved by a nutritious diet and the proper amount of liquid.

If the quantity itself is insufficient it may, to a certain extent be increased by liquids, provided the normal amount is not already being taken. Nature most frequently provides the normal quantity. The complete emptying of the breasts at regular intervals is the chief factor in the production of quantity.

When the quantity is too abundant, which is rare except at the beginning of nursing when the breasts become engorged, the limitation of fluid foods quickly diminishes the flow.

It is a much more difficult proposition to change the proportion of the different ingredients in mother's milk when certain ones are too low or too high on a normal diet. The amount of fat in the diet above a normal amount has very little effect on the fat in the milk. The protein can be modified to some extent. When it is deficient, more protein should be fed in proportion to fats and carbohydrates and more animal protein than vegetable. Milk is believed to produce more protein in mother's milk than any other food. Protein, of course, can be decreased by reversing the above ratio. Hoobler* finds that the mother's diet for the production of the most normal milk should contain six times as much carbohydrates and fats as proteins.

There are two types of breast milk which are seen frequently and their producing factors are so well understood that it seems profitable to mention them here.

*Hoobler: Amer. Jour. Dis. Child., 1917, xiv, 105.

(1) When all the elements are too high, fat 5 per cent; sugar 7½ to 10 per cent; protein about 2½ per cent. In these cases the food is usually very rich and the mother takes very little exercise. This can be remedied by less food and more exercise.

(2) Where the fat and sugars are lower than normal and the protein higher. These occur in mothers who are suffering from overwork and insufficient food. An example of their milk analysis would be fat 1 per cent; sugar 4½ per cent; protein about 2½ per cent; this deficiency can be remedied provided these women can have their duties lessened and are given more food.

A baby thriving on breast milk should be happy, contented, and sleep a good part of each twenty-four hours. The gain in weight should be steady with a weekly gain of about 8 oz. making 2 pounds a month. This should be maintained for at least three months, after which time 4 to 6 oz. a week or 1 pound a month is sufficient. The baby's color should be a good pink, flesh firm, and it should be normally active for its age.

**Evidences of Unsuccessful Nursing.**—*Underfed.*—One of the most frequent conditions is hunger. When a baby gets insufficient food, it will fail to show a normal gain which should begin to take place after the initial loss of weight of the first week. A baby may get just enough food to satisfy its appetite and yet not actually get sufficient for a normal gain. However, most babies will make known their wants by persistent fretting, restlessness, and never seeming quite happy. They want to nurse at the breast an abnormal length of time, thirty minutes or more, and when taken away cry and fret. The fretting is likely to stop after thirty minutes when digestion starts and during this time older children will stop their crying when amused. This proves quite definitely that the crying is not due to pain, but rather to hunger. There will probably be a space of an hour, then the fretting and fussing begins again. Many times they chew their fists or fingers continually when awake. The crying as a rule is never very violent or long continued and several ounces of boiled water will frequently stop the crying for about an hour, which proves again that it is hunger. Then, of course, the baby is getting milk which is insufficient in quantity or quality. The quantity may best be determined by weighing the baby before and after every feeding for twenty-four hours. If the quantity is deficient measures discussed under the mother's diet to increase the quantity should be instituted. If the quantity is sufficient and the quality poor use the measures endeavoring to increase its quality. Remember that artificial feeding does not have to be commenced at once until all the proper efforts to better the milk have been exhausted. Only complementary

feeding is necessary, for breast milk of this character may well be used. Even though mother's milk is poor, if the quantity is present it will serve as a good media and diluent for the complementary cow's milk formula. It is of undoubted value as an aid in helping to digest cow's milk.

*Overfed.*—Just as often we see children who get an excessively rich milk supply. They nearly always are subject to a certain amount of discomfort, depending on the amount and richness of milk in their diet. They are many times fussy, restless, and sleepless individuals who awaken easily and cry a great deal. The cry in this case is sharp and persistent as if in pain. Many times when they are suffering from this so-called colic they cannot be made to take the breast or boiled water because they are too uncomfortable. These babies usually spit up some milk from time to time which is mostly unchanged in character. The stools are often loose, ranging from four to eight a day and containing much undigested food, and later on mucus if the condition is not corrected. These babies usually show a good gain in weight even though they are uncomfortable much of the time and lose a great deal of sleep. Their food is, of course, unusually rich in all elements and the stools in most cases appear distinctly abnormal. These cases are helped primarily through the mother's diet as suggested under mother's regime. If it is impossible to change mother's milk sufficiently to relieve the baby, it may be diluted by allowing the baby to take about an ounce or more, according to age, of boiled water before nursing. The twenty-four hour total of milk consumed may be diminished by resorting to a four hour schedule which would make one less nursing each day. Many times it helps somewhat to allow the baby to nurse a shorter period at the breast, thereby depriving the infant of the so-called "last milk or strippings" which, of course, is the richest. If the baby gains despite all the symptoms of distress, there is no true indication for weaning. A warm bath and colon flush given in the evening is most helpful to relax these cases of colic.

At least some of these cases of extreme discomfort where nothing seems to help, will some day be proved to be sensitization to a protein in mother's milk. It would at least explain why mother's milk is good for some infants and unfit for others.

Any one hoping for results by the use of medicinal agents such as opiates, astringents, and the various intestinal ferments are destined to disappointment. The symptoms of distress or colic must be remedied through the milk as it is the exciting cause. A thorough sweeping out of the food daily with a dose of castor oil gives marked relief. There is no special objection to the use of castor oil, if not used for a protracted

period. If it can add to the baby's comfort and make breast nursing successful during the first week or two, it is worth using. After this time the milk often corrects itself and the baby, growing stronger, is able to digest this rich milk. The stools in these cases are many times acid and literally burn the baby's buttocks due to the fatty acids and fermentation that takes place in the intestinal tract from this overrich diet.

**Weaning.**—It is during the early months of life that breast milk means most to the infant. Every ounce is vital and no infant at this age should be weaned unless it is persistently upset by mother's milk with symptoms of vomiting and diarrhea. A scanty milk supply or poor quality is not an indication for weaning, but for additional feeding. Cow's milk in proper dilution, according to age, must be given commensurate with the baby's needs. It is an easy matter to add one or two bottles each day to the diet and this frequently helps mother's milk to remain constant for several months. When more than two bottles are given the breasts are more than likely to suffer from lack of nursing and the milk rapidly disappear. It is much better to give the bottle formula at certain stated feedings and not mix the two milks. It is an easy matter then to tell which is disagreeing should any symptoms of indigestion appear. It is good practice to begin with one supplementary feeding each day about the third or fourth month. It rests the mother, keeps nursing from being a real burden, and at the same time accustoms the baby to the bottle which if delayed too long the baby may never take at all. When infants do not like their bottle they frequently do not take enough milk and then nutrition suffers. Gradual weaning is much better, as mother's milk in the latter part of lactation begins to decrease in proteins and salt just when the infants need such constituents. These extra feedings make up this deficiency.

Mothers seeking advice about weaning their babies, seemingly successfully fed to about eight months, are surprised to find that they have not gained for a period of three months. This is a frequent occurrence. This represents three months' loss during which time the babies have actually suffered in nutrition. Few mothers are able to nurse their babies entirely at the breast for a longer period than six months. Their weight should be watched carefully during these months in order to judge the need of additional feeding. A baby doing fairly well on breast milk may well be nursed through the summer months and supplementary feeding started later. The articles of so-called table food that babies should have during their first year will be especially considered in the next chapter.

**Conditions Requiring Special Consideration.**—*Menstruation* is no cause for giving up the breast. The milk is diminished some in quality and quantity and part bottle feedings may be given for a few days. It is during the first two or three days of menstruation that milk is affected. Most babies are not upset by it at all, and if so, the upset is not serious in any way. Part bottle feedings may be instituted for several days, then put the baby back to the breast.

*Pregnancy.*—Infants absolutely must be weaned or all three will suffer, mother, baby, and fetus.

*Nervous Impressions.*—Fright, grief, passion, excessive sexual indulgence, or any great excitement may entirely arrest the secretion or so affect its composition as to make the child actually ill (Holt). This is of the most unusual occurrence and does not call for weaning. Artificial feeding may be used for twenty-four to forty-eight hours until the nervous condition is improved.

*All Serious Chronic Diseases.*—No mother with either active or latent tuberculosis should nurse her infant. It breaks down the mother's resistance as well as exposes the baby. Chronic nervous diseases and chronic nephritis; acute contagious and infectious diseases as typhoid, pneumonia, puerperal septicemia, eclampsia are all considered practical contraindications to nursing. In some special chosen cases, the milk may be withdrawn by a breast pump and nursing reinstated after the mother's recovery.

*Syphilis.*—There is no reason for a syphilitic baby's not nursing its mother. If the baby has this disease the mother has it also, and vice versa. The only possible exception would be a child born normal when the disease is no further advanced in the mother than the primary stage.

**Rules to Follow in Selecting a Wet Nurse.**—(1) She must be healthy and free from any possible tuberculosis and lues.

(2) She must have well-developed breasts with an abundance of gland tissue. Probably the best guide as to amount of milk secreted is the size of the breast before and after nursing. Nipples must be well developed and free from fissures.

(3) It is not so important as was once thought that the baby of a wet nurse should be the same age as the infant she expects to nurse. The character of breast milk changes little between one month and six months of lactation.

## 2. Artificial Feeding

When breast milk is insufficient or totally absent, our only easily obtainable staple food for young infants is cow's milk. This is not an ideal food in many respects, but we have to rely upon it in artificial

feeding. Cow's milk to be suitable for an infant (1) must be fresh and should whenever possible be used up by the time it is twenty-four hours old. (2) It must be clean. The proper handling and care of milk can best be fulfilled by adopting the rules laid down by the American Association of Medical Milk Commissions. (3) No preservative should be added. The preservatives themselves are not harmful. Milk that is too old and unfit for infant feeding may in this way be delivered sweet. (4) Milk must be obtained from healthy cows specially tested and free from tuberculosis. (5) Milk should be free from all pathogenic organisms and contain as few of the ordinary lactic acid bacilli as possible. (6) Milk should run a uniform percentage of fat, sugar, and protein, otherwise a normal and rational food formula cannot be figured. It is especially important that the amount of fat be known and remain constant. (7) The milk from a herd of cows is preferable to that from one cow.

**Bacteriology of Milk.**—Under the most improved methods of handling, cow's milk contains thousands of organisms. A sterile milk is impossible to collect owing to the numerous avenues of contamination.

The pathogenic organisms most frequently existing in milk are tubercle bacilli, typhoid, scarlet, dysentery, diphtheria and other organisms causing epidemic diarrheas. The colon bacillus is fairly common. The nonpathogenic organisms belong chiefly to the lactic acid group. Many putrefactive bacteria are present which break up the milk protein. This latter group of organisms is considered harmless unless they are present in sufficient numbers to have produced many toxic substances in the milk. In this case children may be made violently ill. The number of bacteria in milk depends entirely upon the methods of handling. Milk when delivered at the home may be considered good and have a range of from 10,000 to 30,000 bacteria per cubic centimeter.

**Composition and Chemistry of Cow's Milk.**—Human milk, being the only ideal food for the infant, a knowledge of it is essential before a comparison with cow's milk may be drawn.

Cow's milk, like human milk, is composed of fat, sugar, protein and mineral salts. Chemically these are much the same, differing in their quantitative proportions and in their digestibility. A thorough knowledge of these differences is necessary before cow's milk may be modified to the best advantage.

For infant feeding the different breeds of cows make very little difference. The Guernsey and Jersey are more highly bred animals and seem more susceptible to disease and nervous influences than the Holstein and common mixed breeds. The Holstein would seem to be slightly

preferable but the cleanest milk that can be obtained regardless of breed is best for the infant.

The milk from different breeds varies somewhat in its composition. The fat is highest in Guernseys and Jerseys and lowest in Holsteins. A fair example is Table XVIII, taken from Holt.

TABLE XVIII

| | JERSEYS | HOLSTEINS | AVERAGE GOOD HERD MILK |
|---|---|---|---|
| Fat | 5.61 | 3.46 | 3.50 |
| Sugar | 5.15 | 4.84 | 4.75 |
| Protein | 3.91 | 3.39 | 3.50 |
| Ash | 0.74 | 0.74 | 0.75 |
| Total Solids | 15.41 | 12.43 | 13.00 |
| Water | 84.59 | 87.57 | 87.50 |
| Total | 100.00 | 100.00 | 100.00 |

The reaction of cow's milk is either amphoteric or slightly acid, practically never alkaline. The acid salts predominate in cow's milk while the alkaline salts are more abundant in human milk.

*Fat.*—The fat in both milks is in a state of fine emulsion. This state of emulsion being much finer in human milk than in cow's milk is one reason why human milk is much more easily digested. Cow's milk contains a far greater proportion of volatile fatty acids, nearly six to eight times as much as human milk. To this fact is ascribed the marked difference in digestibility of the two fats. We must remember that cow's milk is never so fresh when consumed as human milk. The fat in cow's milk ranges from three and a half to four and a half, averaging four per cent which is practically the same as human milk.

*Sugar.*—Lactose or milk sugar is identical with that of human milk. Cow's milk is relatively low in sugar, containing about one-half as much as human milk. Sugars, like fats, are composed of carbon, hydrogen and oxygen and furnish energy and fuel in the human mechanism.

*Protein.*—The same two classes of protein exist in cow's milk as in human milk. The ratio of the lactalbumin to casein is reversed in cow's milk, the casein being five times as abundant as the lactalbumin. The lactalbumin being far richer in the essential amino-acids than casein makes human milk more valuable than cow's milk despite the fact that cow's milk is nearly three times as rich in protein. Human milk averages 1.25 per cent, while cow's milk averages 3.50 per cent in protein.

The casein in cow's milk is readily precipitated by both rennet and acids. The curds formed are much tougher and denser than in human milk and necessarily much harder to digest.

*Inorganic Salts.*—Inorganic salts are three to four times as abundant in cow's milk as human. The principal salts are in about the same proportion as human milk, the only practical exception being phosphorus. Much of the phosphorus is in combination with the casein which, of course, is far more abundant in cow's milk than in human milk. Even after cow's milk is diluted in formula making, there is still an abundant supply for nutritional purposes. The excess of salts seems to have no injurious effect upon the child's intestinal tract, most of it not being absorbed or, if absorbed, not retained.

*Iron.*—The proportion of iron in cow's milk is very small. In human milk it is figured about 1.5 mgm. per liter or .00015 per cent (Bahrdt and Edelstrin), while cow's milk contains only one-third of this.

**Sterilization of Milk.**—By sterilization is meant the heating of milk at 212° F. for thirty minutes to one hour or more according to the different methods of technic. This kills all pathogenic organisms except the spore-bearing bacteria. It is impossible to render milk absolutely sterile and even sterilization makes it safe for only a few days. Most milk, containing enormous numbers of bacteria, and some of these being pathogenic, the boiling of milk is certainly of advantage in ridding the milk of its bacterial content. There are, however, many disadvantages to sterilized milk: (1) The vitamine content is destroyed. At the present time this is concurred in by most observers, it being a well-recognized clinical fact that infants whose sole diet is sterilized milk are prone to develop scurvy. (2) Changes other than bacteriologic are produced. The taste is somewhat altered and the milk is made more constipating. The milk sugar is sometimes converted into caromel, the lactalbumin is partially coagulated and casein is rendered less coagulable by rennet. Part of the organic phosphorus is changed into an inorganic phosphorus and other lime salts usually soluble are converted into insoluble compounds. This latter group of disadvantages is, however, productive of no specially injurious effect upon nutrition and when it is more necessary to have sterile milk than to give consideration to these points it is advisable to boil the milk.

**Pasteurization of Milk.**—In order that the disadvantages of sterilized milk might be overcome much lower temperatures are now being employed. Practical pasteurization consists in the heating of milk to the temperatures of 150° F. for from twenty to thirty minutes. This is sufficient to kill the bacilli of diphtheria, typhoid, dysentery, tuberculosis, and 99 per cent of all other bacteria in the milk. This does in the main all that sterilization does, and does not produce the different chemical changes produced by sterilization. The vitamine content is

partially destroyed by pasteurization but not wholly as is the case in sterilization. The principle of pasteurization requires the bottles to be exposed on all sides to live steam, the bottles being in a closed vessel. The two most widely used are the Arnold and Freeman sterilizers. In all methods of pasteurizing milk it is necessary that it be rapidly cooled after heating.

Holt gives a method for home-pasteurization which though not accurate is usually very effective. Place the bottles of milk in a covered pot containing enough tepid water to cover the bottles to the neck. Allow this to stand on the top of the stove until the water begins to simmer. Now remove the pot from the stove to a table and let it stand for twenty minutes covered. Then cool the bottles by placing them first in water at room temperature and afterwards in ice water.

*Conclusions.*—1. When excellent (certified) milk can be obtained, raw milk is our first choice because it is altered in no way, no ferments or vitamines being destroyed. The organisms present have no bad effects on the digestion of healthy infants.

2. When good, fresh milk cannot be obtained, the supply should be pasteurized before using for infant feeding. This is productive of no harmful effects. The killing of numberless bacteria certainly does prevent minor digestive upsets and produces more uniformly normal stools.

3. Milk known to have a high bacterial count and to be unsafe for use should be boiled at all times.

4. Infants under three months of age many times thrive better when their milk formulas are pasteurized and over three months this need only be practiced in the hot months. The younger the infant the more susceptible it is to bacteria.

5. There are certain instances when fresh milk is not well borne, then pasteurization should be resorted to.

6. Infants with feeble digestion thrive better on pasteurized milk.

7. All infants suffering from definite intestinal upsets should have their milk boiled or pasteurized.

8. No infant should be fed on boiled milk alone for more than two or three months or over three months of age without supplying vitamines in some other form (See Vitamines).

**The Food Constituents and Their Metabolism.**—It is an easy matter to pattern a cow's milk formula so that it will contain the same proportion of elements as human milk, but this will not suffice. A breast-fed baby has its food proportions the same strength during the whole nursing period. A bottle-fed baby could not take its food so strong at first, or it would have to take practically whole cow's milk. If an

infant is underfed on human milk the progressive growth is slightly retarded, while if overfed, the excess food is either spit up or passes through the intestinal tract undigested or unabsorbed, impairing the child's growth in no way. Occasionally it may cause symptoms of discomfort. This, however, is not the case with cow's milk. Infants may, when underfed, suffer from malnutrition and be made desperately ill when overfed. Therefore, the percentages of ingredients in artificial feeding must be given the most careful consideration and even though we may be able to make almost any conceivable percentage mixture, the chemical character of these ingredients can be changed little. Although the elements of the two milks are much the same in chemical composition there is a wide variation in the way they are digested and assimilated. This brings us to a discussion of the food value and metabolism of the different elements:

*Fats.*—Human milk and cow's milk both contain approximately 4 per cent butter-fat. A young baby takes the same proportion during his whole nursing life and suffers no inconvenience because the fat of the human milk is much more easily digested. A bottle-fed baby should not normally take a 4 per cent fat mixture until it is six months or more of age. Many children are fed higher fat mixtures than is normal in an endeavor to increase their weight. Few young infants can take more than 3 per cent butter-fat without developing intestinal disturbances. The caloric value of fat is very high, being twice that of protein and carbohydrates. For this reason a fair percentage should be used or more carbohydrates and protein would have to be used in proportion to make up this deficit. The fat of cow's milk contains about 8 times as much volatile fatty acids as human milk and this is believed to be one of the chief reasons why fat of cow's milk is harder to digest and more likely to cause severe upsets when given in too high quantities. Fats also serve a distinct purpose in nutrition because of their aid in the absorption of calcium and other salts. You will remember that fats are split in the intestinal tract into fatty acids and glycerine. The fatty acids combine with the alkali in bile salts and the food to form soaps. The soaps are believed to be absorbed as such, the alkali again being set free. Fats, then, are highly nutritious and valuable in the absorption of calcium, but require more careful consideration than any other element in milk modification. It is entirely unwise to feed as much fat as a baby can care for because suddenly an intolerance is developed which may preclude the feeding of fat for several months.

*Carbohydrates and Sugars* serve the same purpose in nutrition as fats, i.e., as fuel and energy. Human milk contains a relatively higher proportion of sugar than cow's milk which would indeed seem to be a

point proving its importance. The sugars are well borne by young infants, easily digested and readily absorbed by the intestinal tract. They further fill an important place in furnishing heat because of their ability to be substituted for fats, few infants being able to take the amount of fat supplied in cow's milk. All three kinds of sugars, milk sugar (lactose), cane sugar (saccharose), malt sugar (maltose) are used in infant feeding. They are digested into dextrose and absorbed as such. The dextrose is built up into fats and glucose, the process not being well understood. These sugars, however, possess certain properties which make them advantageous in certain types of feeding cases.

*Milk Sugar* has a distinct advantage because it does not readily ferment in the stomach as does cane sugar and malt sugar, hence should be our choice in cases of sugar indigestion. It, being much harder to break down, is not absorbed as rapidly in the upper intestinal tract and furnishes a media for the normal intestinal fermenting organisms. Experiments seem to prove that many organisms ferment cane and malt sugar that cannot utilize milk sugar until it is completely broken down. The fact that milk sugar is found in larger amounts in the lower intestinal tract, makes it more laxative than the other sugars, therefore, contraindicated in cases where the stools have a tendency to be loose. Milk sugar should not be given in proportions greater than 7 per cent, else loose stools may follow.

*Cane Sugar* has no special advantage over either lactose or maltose except that it is less expensive. The fact that it ferments into alcohol instead of lactic acid makes it unsuitable for the normal intestinal flora. That infants thrive on it is an undoubted fact. Normal healthy infants thrive on any sugar provided the amounts do not exceed 6 to 7 per cent. Cane sugar is less laxative as a rule than malt sugar and more likely to be the cause of sugar fermentation in the stomach. If cane sugar is used, the percentage should be smaller than of any other sugar.

*Maltose.*—Pure maltose is hard to obtain and the expense precludes its general use. When malt sugar is mentioned a combination of maltose and dextrins is always meant. There are many different brands, each having a different proportion of maltose and dextrins. The dextrins are higher sugars (polysaccharides) and are digested into the disaccharides or maltose, which are eventually split up into dextrose. Some of the chief advantages of dextri-maltose are due to the dextrins. They are not broken down in the stomach. In the intestinal tract they have so many stages of digestion that no great amount of sugar is formed at any one time, thus giving more time for absorption. A higher proportion of malt sugar can be used than of any other sugar, even 10 per cent to 12 per cent. If vomiting should be induced, the intestinal tract

is not usually irritated and the higher proportions may be reduced without any lasting disturbance. They are especially useful in feeding infants recovering from intestinal upsets, as they can be used when other sugars seem to disturb.

*Starches.*—The ferments that digest starches are present in the saliva even of the newborn but this action is of course negligible. The starch-splitting ferments of the pancreas and intestinal tract are present at birth but are not at all abundant during the first few months. Starches are digested by the newborn, but not in any great quantity until after the third month. Starch not only serves the same purpose as fuel that sugar and fats do, but has a helpful effect on the physical property of the proteins. The soluble starch forms a colloidal mixture in which the curds when thrown down are much smaller and softer than in plain water solution. When sugars cause fermentation to the extent that they can be used only in small proportions or not at all, the starches are a valuable substitute because they are similar to the dextrins in not being broken down so rapidly and filling any part of the intestinal tract with high sugar. Starch undergoes no fermentation in the stomach.

*Protein.*—Protein is the basis of all cellular life and growth. It is the only food material that can replace tissue waste and build up new cells. Fats and sugars cannot take its place as they only furnish fuel and energy.

Protein can serve as a source of energy and sustain life for a long time, but it is not valuable as a heat producing food, because its energy value is exceedingly low and its metabolism taxes especially the organs of elimination. Infants need protein to supply waste and build up a growing organism, therefore more in proportion than adults. If an infant does not get sufficient fats and sugars, he may just fail to gain, while if his diet is deficient in protein he will undoubtedly cease to develop.

The ultimate digestion of protein is into the amino-acids and these are far more abundant in the lactalbumin of human milk than cow's milk. Human milk contains throughout lactation only 1.00 per cent to 1.25 per cent protein on which babies thrive. It will be seen at a glance that infants must be furnished more protein in artificial than breast feeding, at least 2 per cent by the time they are one month of age, 3 per cent by 6 months, and 3½ per cent by 9 months; where whole milk is used. Protein is digested and absorbed readily. When fed in excess of the infant's needs, it produces fewer symptoms than either fats or sugars. The excess nitrogen from milk protein has never been found to be harmful to the infant's welfare. Sometimes protein cannot be given in normal quantities on account of improper digestion of curds.

Some infants have the curds coagulated in the stomach into large masses. These resist the action of the digestive ferments, causing the passage of large bean-like masses in the stools. This coagulation is really a mechanical affair and can be prevented in a degree or entirely by, (1) diluting milk, (2) substituting whey for some of the skim milk. In this manner the curd content can be lowered and the protein value raised. (3) Boiling. This is simple and must be continued for 5 to 10 minutes to be of any advantage. The curds formed in boiled milk by rennet are much softer than in raw milk and do not separate completely. (4) Addition of cereal which acts as a colloidal suspension producing less dense curds. (5) Addition of an alkali such as soda bicarbonate, sodium citrate and lime water. The curds are much less dense after these have been added, rennet not acting in an alkaline media. The casein is precipitated much more slowly and if too much is added no curdling will take place. It is still a question of opinion whether this is advisable. Unless there is some plausible reason to correct excessive acidity these alkalies had best not be used as a routine procedure.

*Salts.*—The salts of cow's milk are identical with those of breast milk, being nearly 4 times as abundant. After dilution, sufficient salts are present for digestion and proper metabolism. It is supposed by some that an excess of salts produces some disturbances of metabolism.

Our knowledge is far from complete and the metabolism of salts is so closely allied with proteins that this question cannot as yet be answered. Much of the excess of salts is excreted in stools as calcium phosphate and calcium magnesium soaps.

The salts are as essential to life as the proteins, making up most of our bony skeleton, and combined with protein form most of our tissues. Owing to the infant's more rapid growth, a greater proportion of salts and proteins is needed for growth than in adults. Calcium, which is the most important salt, is much surer of absorption when fat is given in proper amounts. Metabolism data tends to prove that this absorption takes place more completely when the ratio of calcium to fat is near 1 to 20. (Holt.) This is about as it exists in whole cow's milk. Calcium salts are known to greatly diminish muscular irritability while sodium and potassium salts increase this irritability. It is then imperative that calcium be properly metabolized if we wish to prevent such conditions as rickets and tetany. While sodium and potassium are of lesser importance, they are required for proper nutrition and are more likely to be lacking after severe diarrheas.

The only mineral salt deficient in cow's milk is iron. Infants six

months of age who are fed exclusively on milk should routinely be given some other food with iron content to make up this deficiency.

*Water.*—The larger part of our body tissues consists of water, in infants nearly ⅔ their body weight. All the infant's food has to be taken in solution or in suspension so that digestion can take place. Quantities are needed for metabolism of all the different food constituents and for the elimination of all waste material. It is figured that an averge infant must have water to the amount of ⅕ of his body weight to supply all of the body functions. Most of this water is given in formula dilutions.

**How to Choose Amounts of Food.**—While formulas are made, bearing in mind certain features of breast milk, it should be our endeavor to adjust the proportion of elements to the infant's capacity to digest and the amounts needed for proper metabolism. It is from a careful study of the symptoms of digestion and their stools that real success can be had.

Experience has proved that infants thrive on certain amounts of food at certain ages, but this furnished no real scientific basis for making formulas. Metabolism experiments have taught us much that is helpful in choosing correct amounts and really put infant feeding on a scientific basis.

Whatever kind of food is used, it must be sufficient to supply the tissue growth and repair as well as energy requirements and normal growth. An infant's appetite was once thought to be a suitable guide, but he always takes more food than is needed, which, if cow's milk, may and does cause serious trouble.

One must not only be familiar with the exact composition of food given, but must know the energy value of its different elements. This is measured by the calorie, which is the amount of heat necessary to raise one kilogram of water one degree Centigrade. It is definitely known that infants require an approximate number of calories per body pound weight at the various ages. For practical purposes these are:

60 calories per kilogram (25 per pound) during first and second week.

100 calories per kilogram (45 per pound) from two weeks to one month.

120 calories per kilogram (45-50 per pound) from one month to six months.

100 calories per kilogram (45 per pound) from six months to one year.

From the above the caloric needs are less during the first few weeks of life, the greatest number being needed from 1 to 6 months of age, during which time there is the greatest activity and largest gain in weight. After 6 months the caloric needs are less, the necessary gain in weight being much less also. These caloric requirements are all based on the average normal weight for the different ages. Remember, then, that these furnish only a normal average food requirement for the infant and serve only as a basis for computing formulas. For instance, a child who is overactive for its age uses up more energy and will justly require more calories per pound to make up for this extra expended energy. So, also, children who are underweight for their age, require more food than their weight alone would indicate. For instance, a two months' old baby weighing 11 pounds should require the normal amount of calories for an 11 pound infant, while a two months' baby weighing 9 pounds, if given the normal number of calories for a 9 pound baby will in all probabilities not gain. This baby should be fed as if he weighed 10 pounds, and even 11 pounds if he does not gain on the 10 pound quota because this should be the normal weight for his age. Likewise those who are above weight, inactive or sluggish require fewer calories for their body weight. It is to be remembered that while these rules are most helpful and must be followed in our endeavor to approach a normal amount of food, there is a great individual variation. These rules serve as a means of arriving at a starting point until the child's individual variation can be learned. They apply to the caloric needs of a well child and do not take into consideration a child intestinally upset. A child may be overfed in number of calories and yet not gain because it does not properly assimilate some one of the food elements. The proper allotment of the needed calories among the different food elements and applying them to the child's digestive ability will constitute success or failure in infant feeding.

*How to Make up the Baby's Formula.—*

After comparing human milk with cow's milk and bearing in mind the different proportions of fats, sugars, proteins, and salts and their relative digestibility, it certainly seems that whole milk when diluted with water would give the most normal percentages for babies at the different ages. When whole milk of a known percentage is used the formula is simpler to make and the proportions will run more uniformly the same. In whole milk dilutions the percentages of chief ingredients fulfill all rules laid down in the discussion of "The Food Constituents and Their Metabolism." If we observe these proportions in a general way and make the total amount of food sufficient in number of calories we

have to give a certain prescribed amount of food each twenty-four hours. The exact way in which this is given is not of serious import, just so the proper kind is chosen and proper proportions given. Just how much actual fluid food or formula should be given at each feeding is subject to individual variation, but an average for the age and weight is well known. Infants during the first two weeks increase their stomach capacity from 1 oz. to 3 oz. and after one month of age a practical rule is to give one and one-half to two ounces more in the bottle than they are months old. Infants require for normal metabolism about 3 oz. of fluid for each pound of body weight every 24 hours during the earlier months and only 2 oz. after seven months of age. Vigorous, overweight children, of course, will require more than this average to satisfy their appetite. Just how often a baby should be fed depends upon the emptying time of the stomach and the normal sensations of hunger experienced on the part of the baby. This, experience has taught us, is three or four hours. Bottle-fed babies having to take a food which is not ideal and harder to digest than human milk should have it as dilute as possible, to carry the proper number of calories. The three-hour schedule will give an extra feeding and allow more diluting. For young infants this would give seven feedings a day. For example, a formula for a three months' old baby may be arrived at in the following way:

There should be seven feedings a day of approximately 5 ounces each which gives a 35 oz. fluid total. This gives approximately 3 oz. of fluid for each body pound weight. Into this total amount we must apportion enough food for the child's normal growth. Following the rule of ½ oz. to 2 oz. of milk for each body pound of weight a child weighing between 11 and 12 pounds would require from 17 to 24 oz. of milk in the formula and in most cases 20 oz. would be the correct amount.

The formula would then be: whole milk, 20 oz.; sugar, 1 oz.; water, 15 oz.; total, 35 oz. This should be given in seven feedings of 5 oz. each, three hour intervals. The percentages of this formula, fat, 2.30 per cent; sugar, 5.56 per cent; protein, 2 per cent, coincide with the rules already laid down and its caloric value, 520 calories are sufficient for normal growth.

A baby 11 pounds of weight would require 11 times 50 (calories per pound) or 550 calories. This would seem to be about 30 calories deficient which could be supplied by adding 1 more oz. of milk if the child seemed hungry or did not gain in weight.

Table XIX gives a feeding scheme for infants under one year of age with their percentages and caloric values.

It must be remembered that all formulas given under this Table are intended to represent food sufficient for normal growth. In starting any

TABLE XIX

| AGE | WEIGHT | NO. FEEDINGS 24 HOURS | INTERVAL | NIGHT FEEDINGS 6 P.M. | QUANTITY SINGLE FEEDING | QUANTITY 24 HR. FORMULA | MILK | WATER | SUGAR | PERCENTAGES | | | CALORIES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | F – | S – | P – | |
| 1 wk. | 7-8 lbs. | 7 | 3 hrs. | 2 10 P.M. 2 A.M. | 2 oz. | 14 oz. | 5 oz. | 9 oz. | 1 oz. | 1.42 | 8.69 | 1.25 | 220 |
| 2 wk. | 8-9 | 7 | 3 | 2 | 3 | 21 | 8 | 13 | 1 | 1.52 | 8.70 | 1.33 | 280 |
| 1 mo. | 9-10 | 7 | 3 | 2 | 3 1:2 | 25 | 12 | 13 | 1 | 1.93 | 6.28 | 1.68 | 300 |
| 2 mo. | 10-11 | 7 | 3 | 2 | 4 | 28 | 15 | 13 | 1 | 2.14 | 6.11 | 1.87 | 420 |
| 3 mo. | 11-12 | 7 | 3 | 2 | 5 | 35 | 20 | 15 | 1 | 2.30 | 5.56 | 2. | 520 |
| 4 mo. | 12-14 | 6 | 3 | 1 10 P.M. | 6 | 36 | 24 | 12 | 1 | 2.47 | 5.32 | 2.16 | 640 |
| 5 mo. | 14-15 | 6 | 3 | 1 | 7 | 42 | 28 | 14 | 1 | 2.66 | 5.54 | 2.23 | 680 |
| 6 mo. | 16 | 5 | 4 | 1 | 8 | 40 | 30 | 10 | 1:2 | 3. | 6.05 | 2.62 | 720 |
| 7 mo. | 17 | 5 | 4 | 1 | 8 | 40 | 32 | 8 | 1:2 | | | | |
| 8 mo. | 18 | 5 | 4 | 1 | 8 | 40 | 32 | 8 | | | | | |
| 9-12 | 18-22 | 4-5 | 4 | 1 | 8 | 32-40 | whole milk | | Table food is added at this age to furnish food sufficient when more than 1 qt. is needed. | | | | |

baby of a known age and weight on cow's milk formula for the first time all rules laid down in the above table may well be followed except the amount of milk used which should be less by 3 or 4 oz. until the baby becomes adjusted to cow's milk. For instance, a baby two months old weighing 10 pounds should have a total formula of 28 oz. made, but instead of using 15 oz. of milk and 13 oz. of water, it would be well to try 12 oz. of milk and 16 oz. of water, gradually increasing to normal amount.

Any infant perfectly digesting its correct formula may have an additional ounce or two of milk added if the symptoms of hunger are present and the gain in weight is not sufficient.

Fat being the hardest element to digest, newborn babies do better to have their formulas made from skim milk rather than whole milk for several weeks until they become accustomed to the protein, gradually increasing to whole milk.

Sugar is added to the baby's formula to raise its percentage (which is about 2 per cent after dilution) to 4 per cent to 7 per cent as it originally exists both in cow's milk and human milk. If sugar were not added it would greatly diminish the caloric value of the formula and necessitate the use of more fat or protein. Sugar, being well borne by very young infants, is of distinct advantage because it helps to furnish more calories at a time when stronger milk cannot be used, as in the formula for an infant two weeks old. One ounce of sugar is added to all the formulas when the diluent ranges from 10 to 16 oz. This keeps the percentage of sugar within normal bounds, making it unnecessary to calculate the percentage whenever a new formula is given.

The weight of the infant is the safest guide when increasing the formula. During the early months there should be a gain in weight from 6 to 8 oz. a week, then after the fourth month 4 to 6 oz. is sufficient. Hunger proves a good guide in children that are undernourished and they must have more food in proportion to their weight because there is a deficiency in body weight to be overcome. The average well-nourished baby getting sufficient food may not seem satisfied when the feeding is finished, but in a little while, after digestion starts the baby is perfectly happy. To feed this child until his appetite is satisfied would certainly be inviting digestive disturbances. Vigorous children frequently take the limit in milk which is 2 oz. per body pound weight but rarely need more, while a small, less vigorous infant would require the minimum which is 1½ oz. per body pound.

Some infants taking the maximum 2 oz. may show signs of spitting up without other signs of indigestion. This is not necessarily a signal

to change from whole milk dilutions to skimmed milk, but rather to reduce the quantity of whole milk, making up the deficiency in calories by the addition of sugar or cereals.

Formulas for very young infants, especially during the first month are increased every few days and very slightly for an abrupt change at this age may cause an upset. Older infants from 2 to 7 months require a change in formula about every two weeks. A greater increase is not so likely to upset at this age. The feeding scale given is for even months of age, so it may be well to call attention to the infant of 3½ months who will need a formula half way between the one used for infants from three to four months.

Whole milk is not applicable to every infant and no inflexible rule can be made. It is necessary that certain facts about the history of the case be known before the first formula is given. It is important to know what formula the infant has been taking and in what quantity, whether the infant has thrived and has been contented or whether such symptoms as diarrhea, constipation, or vomiting have been present.

**Determination of Percentages of Any Formula.**—For example, take the formula from Table XIX for an infant three months of age: milk, 20 oz.; sugar, 1 oz.; water, 15 oz. Multiply the percentage of each element by the number of ounces of that food used and divide by the total number of ounces in formula.

The fat will be $4 \times 20 = 80 \div 35 = 2.3$ per cent fat.

The protein will be $3.5 \times 20 = 70 \div 35 = 2$ per cent protein.

The sugar will be $4.75 \times 20 = 95 \div 35 = 2.70$ per cent when 1 oz. of sugar is added to a 35 ounce mixture it makes practically 3 per cent more sugar to be added, making a total of 5.70. The exact amount is 1:35 of $100 = \frac{100}{35} = 2.85$ which coincides with percentages in table for this age.

**Determination of Caloric Value of Any Formula.**—This may be calculated by ascertaining the caloric value of each ounce of food when its percentage composition is known. A very simple method though not extremely correct is Holt's Modification of Froley's (Arch. Pediatrics, 1912, p. 123) as follows: Double the percentage of fat, add the percentage of sugar and protein and multiply by 1.3. Take, for example, the percentages and formula for a baby two months of age from Table XIX: Fat, 2.30; sugar, 5.56; protein, 2. It would be $4.60 + 5.56 + 2 = 12.16 \times 1.3 = 15.8$ cal. per ounce of food; 15.8 calories × 35 (total amount of

food) gives 553 calories. A simpler way and even more correct way is to multiply the caloric value of each food by the amount of it used in formula. Again take the same formula used above for an infant three months of age: whole milk 20 oz., sugar 1 oz., water 15 oz. = total 35 oz.; 20 oz. of milk × 20 calories = 400 calories in milk, plus 120 calories in sugar = 520.

TABLE XX

THE APPROXIMATE CALORIC VALUE OF THE DIFFERENT FOODS USED IN INFANT FEEDING DURING THE EARLY MONTHS

| | 1 OZ. | 1 TBSP. | | 1 OZ. | 1 TBSP. |
|---|---|---|---|---|---|
| Human Milk | 20 Calories | | Cow's Milk | 20 | |
| Top Milk | 30 | | Skim Milk | 14 | |
| Cream | 60 | 30 | Whey | 10 | |
| Dextrimaltose | 120 | 40 | Butter-milk | 10 | |
| Cane sugar | 120 | 60 | Dried Milk | 127 | 40 |
| Milk Sugar | 120 | 40 | Evaporated | 55 | |
| Barley Flour | 100 | 35 | Barley, gruel | 10 | 5 |
| Wheat Flour | 100 | 25 | Orange juice | 15 | 8 |
| Oat Flour | 115 | 40 | Beef juice | 6 | 3 |

Cane sugar 1 oz. by weight is approximately 2 level tablespoonfuls.

Milk and malt sugar 1 oz. by weight is approximately 3 tablespoonfuls.

Barley and oat flour 1 oz. by weight is approximately 3 level tablespoonfuls by volume.

Wheat flour 0 oz. by weight is approximately 4 level tablespoonfuls by volume.

**Conditions Requiring Special Modifications.**—*Fat Indigestion.*—Formulas made from whole milk are adaptable to the greatest number of infants. Whole milk dilutions, even in the hands of the ignorant and careless mother, are most likely to agree because in these formulas all elements are present and none of them are in too high a proportion. Many vigorous infants with good digestions may, and do take formulas with higher fat. In these cases 7 per cent top milk may be used. There is never any need of using a higher percentage of fat than this.

On the other hand, there are infants who do not handle fat well even in whole milk dilutions. Where high fats are used the increase should be made very gradually as an infant once upset from too high fats may be unable to take even a small amount for many weeks.

Vomiting is the most constant symptom of fat indigestion. There is frequent regurgitation of milk which is curdled and may take place at any time from one-half hour after a feeding, continuing until time for the next feeding.

Other causes may produce vomiting which are not referable to the percentage of fat, such as taking the food too rapidly, in too large

amounts or too frequent feedings. When vomiting occurs soon after feeding, it is usually due to too great an amount. Another frequent cause is when an infant takes its feeding lying on its back. In this position much air is swallowed and collects in the lower part of the stomach which cannot be expelled until the infant is changed into an upright position by holding over one's shoulder.

The stools are much less frequently affected by an excess of fat and may even appear normal. Many times they are loose, from 3 to 6 times a day, oily, undigested, and contain mucus if the condition has existed very long. Even constipation is seen in which the stools are bulky, well formed, and having an excess of unabsorbed soaps. These cases of fat indigestion should, if fed on top milk dilution, be changed to whole milk. If these symptoms continue on whole milk, then partially skimmed or skimmed milk should be used.

Skimmed milk must be used as the basis of the formula in such cases. More protein and carbohydrates must be added to make up for the deficiency caused by the lack of fats. A safe rule to follow in calculating a skimmed milk formula is to use 2-2½ oz. for each body pound weight instead of 1½ oz. as used in whole milk formulas. Additional carbohydrates are added to bring the formula up to the required number of calories. For example, take an infant two months of age, weighing 10 pounds, a normal formula should be skimmed milk 20 oz., sugar 4 tablespoonfuls and boiled water 8 to 12 oz. This gives a total of from 28 to 32 oz., the caloric value of which is 440; the calories actually needed are 420.

**Sugar Indigestion.**—Regurgitation is also a symptom of sugar indigestion when the fermentation takes place in the stomach. There is frequent spitting up (not actual vomiting) of small amounts of thin, watery material which usually has a very sour odor. Especially is this the case when cane sugar is used, and less often with malt sugar. These cases show marked improvement upon the substitution of a less easily fermentable sugar, preferably lactose. Where the fermentation has existed for a long time it is best to omit all forms of sugar. Starches afford a valuable substitute for sugar given in the form of cereal water. These pass through the stomach unchanged.

There is a type of case characterized by constant spitting up of larger quantities of milk, which is from neither fat nor sugar indigestion. This occurs in neurotic infants who are many times the victims of irregularity. The condition is actually one of pyloric spasm and must not be confused with the food indigestion. All kinds of formulas, even water,

will be regurgitated, proving that the spitting is purely mechanical. This class of infants should be overfed rather than underfed, a stronger formula being preferable to a weaker one because it is much more likely to be retained. The feeding of high cereal formulas is very valuable in these cases making a thick colloidal mixture which is not easily regurgitated. The object is that enough be retained and passed through the pylorus to insure normal growth. These cases practically never show intestinal indigestion and have perfectly normal stools.

When sugar is not properly digested in the intestinal tract the fermentation produces loose, greenish, yellow stools which are usually frothy and have a sharp sour odor. The amount of mucus present depends on the amount and duration of the fermentation. This rarely occurs unless the amount of sugars and starches has been excessive or above 7 per cent. To correct this it is only necessary to withhold all sugars and starches for a few days until the fermentation and acid stools disappear. A normal amount of sugar may be gradually added up to the point of tolerance. Malt sugar for reasons already laid down, is preferable. These infants are usually uncomfortable and restless but seem rarely to experience any actual pain. Sugar and starch indigestion occurring in a lesser degree where the fermentation is not sufficient for the laxative effect may be accompanied by constipation and flatulence.

**Protein Indigestion.**—When protein is coagulated into large solid curds the density of this material may cause it to be vomited. This, however, is rare unless the percentage of protein is extremely high. Although protein requires more energy to digest, the actual symptoms ascribed to protein indigestion are very few. The intestinal tract when overloaded with nitrogenous material produces fewer symptoms than does an excess of fat or sugar. Protein in the intestinal tract affords a putrefactive media producing an alkaline stool and consequently tends markedly to cause constipation and flatulence. The habitual colic of young infants may be caused by any of the above-mentioned forms of indigestion; just as often it is due to an excessive amount of all the elements. The symptoms are always aggravated no matter from what cause, when constipation is present. When the protein is coagulated in the stomach into hard, tough curds, they may be of such density as to pass through the intestinal tract undigested. These undigested curds appear in the stool as hard, leathery, beanlike masses. They, many times, are the cause of a great deal of discomfort to the infant. This condition is not frequently met with. Lowering the amount of protein, boiling the milk or the substitution of whey for some part of the protein usually causes the immediate disappearance of these curds.

### 3. Table Food During the First Year

No other known food contains so many different food elements and in such proper proportions as does milk. It is necessary that milk in some form be used as the foundation of an infant's diet. While it is not impossible it is at least very unwise to attempt to give an infant a diet sufficient in number of calories made out of foods other than milk. Other forms of sugar and carbohydrates may be substituted for the sugar in cow's milk, but this is not the case with the fat and protein. The vegetable fats cannot be entirely substituted for animal fats and no other protein food is nearly so rich in the essential amino-acids.

Milk contains all three classes of vitamines, being fairly rich in vitamines A and B. Of all the elements necessary to life, milk is most deficient in iron. Infants fed exclusively on milk sometimes show a deficiency in color after eight months of age. To make up for this, foods containing iron may well be added to the diet.

A few infants do not thrive on milk and do not seem to assimilate it. In such cases, other foods may well be substituted for some of the milk.

Many articles of food are fed to children under one year of age without any evident harm. The tendency at the present time is to feed too much table food. One could be more liberal in the use of these foods with children who have arrived at the age of seven to nine months not having assimilated cow's milk particularly well. Always remember that some part of the malnutrition at this age may be due to the constant use of boiled milk. Raw milk is always preferable after seven months of age.

The carbohydrates in the form of cereal water or cereal gruels are among the first foods to be given infants. The cereal waters are used frequently as diluents for milk, when it is not advisable to use too high fats or sugars. The starches or farinaceous foods are a very convenient form of energy, because infants over three months of age possess a marked ability to metabolize it. (The cereal flours need only be cooked twenty to thirty minutes while the cereal jellies made mostly from the grains, must be cooked for two to three hours and strained.) The cereal jellies are properly fed after six months of age to most children. Enough of the baby's formula is added to the gruel to make it the proper consistency so as to be more easily fed with a spoon.

These are given at a regular feeding time beginning with two to three teaspoonfuls, increasing to four tablespoonfuls by the end of the first year. The most frequently used cereals are oats, barley, wheat, arrowroot, and rice.

Orange juice is a valuable adjunct to the diet and may be given regularly to infants over two months of age. Where boiled milk is being

used it is imperative that orange juice be used. A tablespoonful may be given diluted with an equal part of water, enough sugar being added to make it palatable. Ordinarily this is given midway between feedings because of its acidity. It occasionally causes spitting up of curdled milk if given with or too near a feeding. As much as two ounces may be given by the time the infant is a year old. The giving of orange juice is a preventive measure as well as a curative one in scurvy. Other fruit juices, especially prune juice, are usually added after four months of age—given in a very dilute form. Beef juice is normally instituted about eight months of age and should be given as early as six months if there is deficiency in the infant's color or lack of normal growth. Two to three teaspoonfuls are given at first, increasing to one ounce by one year of age. It may be given straight or mixed in with the cereal. To obtain beef juice, take a small piece of lean, round steak, cut into fine pieces and place in a small jar with a closed top. This is placed in water at temperature just under boiling and kept at this temperature for fifteen to twenty minutes. The juice is pressed out in a meat press or potato ricer and a small amount of salt added.

In order to give a growing organism the advantage of the vital principles of vegetables, it is well to give a vegetable soup at about nine months of age. It may be given earlier, even at seven months of age if proper growth is not taking place on cow's milk.

To make vegetable soup, grind or cut into fine pieces a quarter of a pound of lean, round steak and let stand in cold water for forty-five minutes. This is done in order to draw out all the juice from the meat, which will not take place if the raw meat is suddenly brought to a boiling temperature. Such vegetables are added as carrots, turnips, or beets, along with green vegetables as spinach or asparagus. These should be cut up very fine. Some form of cereal or cereal flour may well be added for its food value. It also makes the soup much more palatable for children, as they are usually thoroughly accustomed to its taste by this time. These should be allowed to simmer for about an hour and a half until thoroughly well done. Season with salt to taste and strain. Toasted bread crumbs may be added. As much as an ounce of this may be given to start with, gradually working up to two to three ounces during the year.

All articles of table food mentioned so far, when properly prepared, are not one bit harder for the average child to digest than cow's milk. To refuse to feed these articles of food to infants because they are slightly below par is certainly a great error. They can do the baby no harm and most times are productive of the greatest results. Among the poorer classes the feeding of solid foods is much overdone, while

among our well-to-do the opposite extreme is usually practiced and children are allowed to remain on an exclusive milk diet for a year or more.

The early feeding of solid foods with a spoon has a distinct advantage in training the child to take articles of food which they may never learn to eat if put off too long. It is also a valuable aid in the giving of the proper foods to breast-fed infants.

All rules laid down here for the feeding of solid food apply equally well to the breast-fed infant, as to those fed on the bottle.

Other articles sometimes fed to infants under one year of age are well-mashed cooked fruits, strained vegetables such as those mentioned for use in the vegetable soup, and coddled eggs. Many healthy, robust children are given these articles from ten months to a year with no consequent harm, but it is to be realized that these belong more properly to a child's diet during the second year. Milk is just as valuable during the second and third years and is not in any way to be eclipsed by table food. When milk is discarded at the end of the first year, many intestinal disorders arise consequent to the feeding of too much and improperly chosen table food.

### Some Special Food Preparations

There are special instances where the plain milk dilutions from top milk, whole milk and skimmed milk will not suffice. The use of some special milk preparations in which the chemical nature of the food elements has been changed will help solve some of the rarer problems in infant feeding.

**Whey** is made as follows: To one quart of lukewarm milk is added one or two teaspoonfuls of liquid rennet or one junket tablet. Stir sufficiently to mix well and allow to stand, covered, at room temperature, until thoroughly coagulated. This mixture is thoroughly broken up with a fork or an egg beater and strained through muslin or a salt sack.

It can be made either from whole milk or skimmed milk, preferably the latter. The composition varies according to the way in which it is made. An average composition is fat 0.32, sugar 4.75, and protein 0.86. This gives a milk with a faint trace of fat, sugar that is the same percentage as whole milk, and protein that is little less than mother's milk in percentage, having all the insoluble casein removed. It is then a valuable basis for a formula when a low fat is desired as well as to correct symptoms of protein indigestion which is always caused by the casein. Its composition is such that when undiluted it will serve as an infant's sole food when a little carbohydrate is added to make up for

its caloric deficiency in fat. The protein being lactalbumin, is very rich in the amino-acids. This makes it a valuable food for undernourished infants with feeble digestion where the amino-acids are so essential. The absence of casein and the presence of milk sugar in whey make it essentially a laxative food. It is therefore a valuable help in the cure of constipation from high protein. Its laxative effect makes it undesirable as a food or formula diluent when diarrhea is present.

**Protein Milk** (Eiweiss Milch of Finkelstein).—To make this the milk is coagulated with rennet as in the making of whey, except that the coagulum is not broken up but poured upon several layers of cheesecloth or heavy muslin to allow the whey to drain off. This is allowed to stand an hour if necessary. During this time the curd is washed several times with cold boiled water while on the cheesecloth and allowed to dry. This removes the soluble albumin, soluble salts, the sugars and a very small portion of the fat. The dry curd is then rubbed through a fine sieve with a vegetable masher or any flat object, buttermilk to the amount of a pint being added. Boiled water is then added in quantity sufficient to make one quart.

The average composition is given as fat, 3 per cent, sugar, 1.50 per cent, protein, 3.75 per cent.

The taste is somewhat acid and is not very palatable to older children. It is made much more pleasant by the addition of one or two grains of saccharine. Sugar must not be added.

The advantages of this milk are due to its low sugar content, high or practically normal protein content and the insoluble salts. The absence of starch and extremely low sugar make it an admirable food for all acute and chronic fermentative conditions of the stomach and intestinal tract, particularly the summer diarrheas. The protein, which is chiefly curd, having been finely divided, is well borne by the stomach and is especially applicable where vomiting is present. The high protein furnishes an abundance of nitrogenous material which tends to check intestinal fermentation. The fat with the insoluble salt forms soaps that favor the production of formed stools.

This can be used straight or diluted according to the individual case. When the curds are finely divided as they should be, this mixture passes freely through an ordinary nipple. A larger hole may be made in the nipple if necessary, to allow a freer flow.

**Buttermilk.**—All kinds are made by the fermentation of one or more strains of lactic acid organisms. It may be made from either whole milk or skimmed milk, depending upon the desirability of the fat. Buttermilk prepared for commercial purposes is usually made from soured milk which contains many strains of lactic acid organisms and

most times is made from skimmed milk. The bacterial content of this is extremely high and it should be boiled before using for infant feeding.

Specially fermented milk can be made from either whole milk or skimmed milk which will be much purer and contain one or more purified strains of lactic acid organisms. The sweet milk used is first boiled from three to five minutes to remove most of the bacteria. This is allowed to cool to room temperature, when some specially prepared lactic acid organisms are added and allowed to stand at the same temperature for from twelve to twenty-four hours, depending on the amount of acidity desired. The milk usually coagulates. This is well beaten with a Dover beater and placed on ice to prevent any further growth of organisms. Its taste is not at all unpleasant and it is well taken by most children. When the absence of fat alone is desired this is made from skimmed milk and has a composition of about .50 per cent fat, sugar 4 per cent, protein 3.50 per cent. When some lactic acid and pure strains of this organism are desired it may be made from whole milk having the same proportions.

Buttermilk and especially the protein milk, are valuable to correct certain symptoms of indigestion and should not be looked upon as a staple food for long-continued use.

**Peptonized Milk.**—At one time when milk protein was believed to be the hardest element in milk to digest, the peptonizing of milk was carried out in many difficult feeding cases, hoping to prevent the coagulation of milk in the stomach and partially digest the protein. As a matter of fact this indication rarely arises. If the protein needs to be altered it can be done in many other ways as has been before suggested. Its taste is bitter and it is not well taken by infants. It is made by the addition of a peptogenic powder to the milk about thirty minutes before feeding.

**Dried Milk.**—This is made by driving off all water from the milk, leaving it in powdered form. It is made from whole milk or milk ranging from 2 to 3 per cent butter fat. This gives a sterile milk which when mixed with water in proportions of one part by weight to ten parts water makes the same proportions as whole milk. The elements are usually very easy to digest, and if sugar is added, formulas very similar to those from whole milk may be made. It is of greatest convenience to use when traveling and temporarily when good fresh milk cannot be obtained. When dissolved in water the formula has the advantage of being fairly low in sugar and fat and high in protein. This commends it in a general way for the same purposes as skim milk, and protein milk. In cases when raw milk is not well borne and

in the diarrheas of hot weather, it can be used with good results. It should not be used over long periods of time and can in no way replace raw milk.

## V. RECIPES FOR INVALIDS' FOODS

### Preparations of Milk

#### Peptonized Milk

1 pt. milk. 1 tube (Fairchild's) peptonizing powder.

Dissolve the powder in 1 gill of cold water, and place in a clean quart jar (glass).

Pour in 1 pint of cold milk and stop the bottle with cotton, shake well and place the bottle in a saucepan containing water just warm enough to allow of the hand's being immersed without being burned (115° F.).

Keep the water at this temperature for 5 to 10 minutes or longer according to the degree of peptonization desired. Lift out of the warm water and plunge into cold, then place at once on ice.

The milk may be poured from bottle into a clean saucepan and brought quickly to a boil to prevent further peptonization; this process, however, is apt to make the milk very bitter and should not be used unless it is to be flavored with fruit juice.

#### Albuminized Milk

6 ounces (¾ glass) fresh whole milk. 1-2 whites of egg.

Have the milk thoroughly chilled.

Clip egg whites with scissors and strain through cheese-cloth to remove stringy parts. Now stir into the milk with a fork.

If the patient does not object to foam, the mixture may be placed in a milk shaker with pieces of ice and shaken until creamy, then poured over cracked ice.

#### Junket

Can be made from action of pepsin on milk but only in the presence of an acid milk. Best to use rennet, which is a stomach enzyme having exclusively the property of curdling milk. It has no ability to digest albuminous matter as pepsin has. The two ferments are usually found together, and probably the ability of pepsin to curdle milk is due to the rennet associated with it and not separated in the process of preparation. The best tablets are those made from the fourth stomach of the calf, thus containing pure rennet. The Junket Tablets made by Chr. Hansen's Laboratory, Little Falls, New York, are good.

To prepare, add one junket tablet dissolved in a tablespoonful of water and added to a quart of warm milk with or without sugar or other flavoring. Place the milk in a warm place (best temperature 98° F.) and leave 15 minutes.

### Eggnog

Beat until very light the yolk of one egg and a teaspoonful of sugar; then add the white of the egg beaten to a stiff froth. Stir well together, pour into a glass, and add a teaspoonful of rum or brandy and as much milk as the glass will hold. It will give more nourishment if whipped cream is used instead of milk.

Serve with grated nutmeg over the top.

### Milk Toast

Pour scalding milk over dry toast. A tablespoonful of butter may be added to each quart of milk. To prevent scorching, heat the milk in a double boiler.

### Cream Toast

Caution: The main point is to pour the milk over the crisp warm toast at the very last moment and serve quickly.

Put one quart of milk in a double boiler. When hot, add one tablespoonful of cornstarch, moistened in three tablespoonfuls of cold milk. Cool, and stir until it is the consistency of cream; add one teaspoonful of salt, one tablespoonful of butter, and pour at once over warm crisp toast.

## Preparations of Eggs

### Shirred Eggs

Butter small individual dishes and drop an egg carefully into each, taking care not to break the yolk. Set the individual dishes in a pan of boiling water on the stove, and cook until the white is set. Put on each egg a bit of butter, and a dash each of pepper and salt. Serve at once.

### Egg Soup

In a double boiler heat a quart of milk into which you have stirred a pinch of soda. Rub to a paste a tablespoonful, each, of butter and flour and stir into the milk. Season with pepper and salt to taste.

Place six poached eggs in the bottom of a dish and when the white soup is smooth and cream-like, pour it carefully upon the eggs.

### Boiled Custard

Heat a quart of milk in a double boiler, but do not bring it to the boil. Beat five eggs light and stir into them half a cup of sugar. On

this mixture pour the scalding milk very gradually, beating all the time. Return to the double boiler, and cook, stirring constantly, until the custard is thick enough to coat a spoon. If boiled longer than this it will curdle and separate. Remove the custard from the fire, season with two teaspoonfuls of vanilla and set to cool. When cold, nearly fill glasses or cups with the mixture and heap with a meringue made of whites of two eggs beaten stiff with two tablespoons of sugar.

### Baked Custard

Proceed same as preceding recipe until you have poured the hot milk on the eggs and sugar. At this point flavor the mixture with two teaspoonfuls of vanilla, turn it into a baking dish, put it in a pan of boiling water, and bake in a moderate oven. When the custard is firm it is done.

### Floating Island

Heat a pint of milk to scalding in a double boiler. Beat the yolks of 3 eggs stiff—setting the whites in the ice box until they are needed for a meringue. Into the whipped yolks stir 3 tablespoons of granulated sugar, and pour the scalding milk gradually upon these. Return to the fire and cook, stirring all the time, until the custard is thick enough to coat the spoon. Remove from the fire, and, when the custard is cool, flavor with a teaspoonful of vanilla and turn into a glass bowl. Whip the chilled whites to a stiff meringue and beat into this, a little at a time, 3 tablespoonfuls of sugar.

## Jellies

### Wine Jelly

To 1 pint of cold water add one box of Cox's Gelatin. Dissolve and add one scant quart of boiling water, the juice of two lemons, and the rind of two lemons thinly pared, one quart of sherry, one pint of sugar and two or three pieces of stick cinnamon, the whites of two eggs well beaten and crushed shells of eggs to make the jelly clear.

Boil all together about 15 minutes and strain through flannel.

### Coffee Jelly

Soak one-half box gelatine in one-half cupful cold water. Put a cupful of sugar and one of water over the fire, and stir to a quick boil. Pour it over the gelatine and stir until it is dissolved. Add two cupfuls of strong, clear, black coffee, and strain. Turn into wet molds. Serve with whipped cream.

### Tapioca Jelly

Soak a half cupful of tapioca overnight in a cupful of cold water. Put into a double boiler a pint of boiling water and dissolve in it a table-

spoonful of granulated sugar. Now turn in the soaked tapioca and cook until clear. Remove from the fire and add two teaspoonfuls of lemon juice. Have ready jelly glasses wet with cold water, and turn the liquid jelly into these. Set in a cold place to form. Serve very cold with cream.

### Rice Jelly

Wash a cupful of rice and soak it for 2 hours in a cupful of water. Have ready on the stove a quart of boiling water and turn the rice and the water in which it was soaked into this. Boil for three-quarters of an hour, then strain through a muslin bag. When cold and thick, serve with powdered sugar and thick cream.

## Orange Juice Preparations

### Orangeade

| | |
|---|---|
| Juice of 1 orange. | Juice of ½ lemon. |
| 1 tb. sugar. | Enough water to fill the glass. |

Sweeten the juice of orange and lemon and pour into a glass filled with crushed ice. Fill glass with plain or carbonated water.

### Albuminized Orange

Make orangeade as above, without adding water. Break the whites of 2 eggs into a saucer and with scissors cut the albumen until free from membrane and strain. Stir this into the orange juice and add several pieces of cracked ice.

### Frozen Orangeade

| | |
|---|---|
| Juice of 3 oranges. | Juice of 1 lemon. |
| 1½ cups of water. | ½ cup sugar. |

Boil the sugar and water 10 minutes, remove from fire and add orange and lemon juice. When cold add the unbeaten white of one egg and freeze.

## Recipes for Constipation

### Bran Biscuits

| | |
|---|---|
| ½ cup wheat bran. | 1 teaspoonful melted butter. |
| ½ cup improved graham flour. | 1 saltspoon salt. |
| 1 teaspoonful baking powder. | Milk. |

Sift dry ingredients, rub in the butter, add milk to make a soft dough. Roll it out and bake in a hot oven.

### Bran Mush

2 cups bran.
2 cups boiling water.
1 teaspoonful salt.
1 cup chopped dates or figs.

Add bran to boiling salt water and boil three to five minutes. Cook one hour in a double boiler, adding the figs or dates ten minutes before the mush is done.

### Bran Bread (Sour Milk)

2 cups thick sour milk, or butter milk.
2 teaspoonfuls fat, melted and cooled.
1½ teaspoonfuls salt.
2 cups bran.
4 cups graham flour.
1 teaspoonful soda.
1 cup molasses (not black).

Mix the dry ingredients thoroughly. Mix the liquid ingredients (including the fat). Add the dry to the liquid ingredients and mix only enough to blend well. Bake one and one-fourth hours.

### Sweet Milk Bran Bread

3 cups bran.
1 cup flour.
1 tablespoon sugar.
½ tablespoon butter.
½ teaspoon salt.
1 teaspoon baking powder.
1 cup milk.
1 egg.

Proceed same as preceding recipe, except time of baking which is 45 minutes.

### Laxative Fruit Cake

Of each equal parts.
- Senna Leaves.
- Figs.
- Dates (freed from stones).
- Prunes (freed from stones).
- Raisins (freed from stones).

Chop fine in a chopping bowl, mix by kneading, roll into cylinders as thick as a thumb.

Dose: 1 slice.

## Recipes for Diabetics

### Diabetic Bread or Biscuit

1 box Lister's Diabetic flour.
3 eggs.

Method.—Separate whites and yolks of eggs. Add to whites salt to taste. Beat whites until very thick. Beat yolks until thick and lemon

colored. Combine and beat with egg-beater. Fold in gradually one box of Lister's Diabetic Flour. Bake in tin 5 inches long, 3 inches wide and 3 inches high (straight sides). Have oven hot. If baked in gas oven, bake 15 minutes, full heat, then reduce heat one-half for 10 minutes longer. If baked in coal or wood oven, bake from 15 to 30 minutes. Do not remove from tin until partly cooled. Each loaf contains protein, 58 grams; fat 18.6 grams; calories, 397. If desired this may be made into biscuits. The bread or biscuits may be flavored with nutmeg or cloves.

### Diabetic Muffins

1 Box Lister's Diabetic Flour.
1 Egg.
3 Tablespoonfuls sweet heavy cream (40 per cent cream).
2 Tablespoonfuls bacon fat.

Same quantity of butter, melted lard or Crisco may be used in place of bacon fat. This will make 8 muffins, each muffin having food value equivalent to one egg (or protein, 6 grams; fat, 6 grams; calories, 78).

Method.—Beat white of egg very stiff; beat yolk separately from white; to the beaten yolk add the cream and beat; then add bacon fat (butter, melted lard or melted Crisco); beat again, then add the beaten white of egg; lastly the flour, beating the mixture all the while the flour is slowly added. Put in buttered, hot muffin irons and bake for 10 to 20 minutes. If coal range is used, bake for 15 minutes and have the oven hot. Use old-fashioned cast-iron muffin iron.

### Baked Soy Beans

Yellow Soy beans, 120 grams, are soaked for 48 hours, then boiled for about half an hour and finally baked with 30 grams pork for 12 hours. The food value is approximately as follows:

| | Carbohydrate, grams | Protein, grams | Fat, grams |
|---|---|---|---|
| Soy beans, 120 grams | 0 | 48 | 24 |
| Pork, 30 grams | 0 | 4 | 12 |
| Baked Soy Beans and Pork | 0 | 52 | 36 |

### Agar-Agar Jelly

One-eighth to one-quarter ounce is sufficient to make one quart of jelly. The agar-agar is added to the boiling water. After it is thoroughly dissolved and cooking completed, flavoring extract, coloring matter and saccharin are added as desired. Agar-agar may also be added to broths.

### Thrice-Cooked Vegetables

"The vegetables are cleaned, cut up fine, soaked in cold water and then strained. The vegetables are then tied up loosely in a large square of double cheese-cloth—large enough so that the corners of the cheese-cloth, after it has been tied up with a string, make conveniently long ends, and also large enough to allow the vegetables to swell without sticking together. They are then transferred to fresh cold water, placed on the fire and brought to the boiling point, at which temperature they are maintained for from three to five minutes. This water is then poured off and replaced by fresh, and the vegetables again boiled a similar length of time. Three changes of water are usually sufficient to remove the carbohydrate, as has been proved by Professor Wardall's preliminary experiments. The pots for the vegetables should be of sufficient size to hold a large quantity of water, and in a hospital, vegetables enough for the daily supply of 6 patients. Vegetables thus cooked will keep in cold storage two or more days, and reheating them in a steamer is a simple affair.

"If the vegetables are cooked, with the cover left off the pot, they will be lighter in color, and the flavor not so strong." (Joslin *Diabetic Manual.*)

## References

Baumgarten, Fischel and Soper: Hospital Diets, Jour. Missouri State Med. Assn., August, 1921. An excellent list of diets.

Carter, Mason and Howe: Nutrition and Clinical Dietetics. A good clinical text.

Coleman: The High Caloric Diet in Typhoid Fever. A Study of 111 Cases, Am. Jour. Med. Sci., Jan. 1912, cxliii, No. 1, p. 77.

Coleman, Warren: A New Diet for Peptic Ulcer, Jour. Am. Med. Assn., Sept. 20, 1924, lxxxiii, No. 2.

McCallum, Hess, et al.: Symposium on Vitamins. Jour. Am. Med. Assn., Sept. 21, 1918, lxxi, No. 12.

Minot and Murphy: Jour Am. Med. Assn., August 14, 1926, lxxxvii, No. 7.

Osborne and Mendel: Feeding Experiments with Isolated Food Substances, Carnegie Institute of Washington, Publication No. 156.

Sansum, Blatherwick and Smith: The Use of Basic Diets in the Treatment of Nephritis, Jour. Am. Med. Assn., Sept. 15, 1923, lxxxi, No. 11.

Shaffer and Coleman: Protein Metabolism in Typhoid Fever, Arch. Int. Med., 1909, iv, 538.

Sherman: The Chemistry of Food and Nutrition. A small book, but a classic of clear and complete presentation of the subject.

Smith, Gibson, and Ross: The Diet in the Treatment of Cardiac Failure, Jour. Am. Med. Assn., June 18, 1927, lxxxviii, No. 25.

Strauss: Food for the Sick. A book for the patient.

Vanderhoof, Douglas: A Medical Cure for Duodenal Ulcer, Jour. Am. Med. Assn., July 30, 1927, lxxxix, No. 5.

Van Slyke: The Amino-acids, Harvey Society Lectures, 1915-1916.

Woodyatt: Intermediary Carbohydrate Metabolism, Harvey Society Lectures, 1915-1916.

## CHAPTER VI

## HEAT AND COLD—HYDROTHERAPY

In discussing therapeutic measures too exact a classification of them is impossible and indeed undesirable. I have attempted in this book to place most of them in categories, but find that a number are left over which fit in nowhere. In reviewing the matter carefully, however, I have come to the conclusion that the various measures for bringing heat and cold to the body have the same physiologic basis. In my original plan I had a separate chapter for hydrotherapy and another for the use of hot air, electric cabinet baths, electric bake ovens, etc. But it is my belief that they may all be advantageously included under one term and idea—the use of heat and cold—that a hot compress acts in much the same way as an electric pad, that a hot air bath acts in much the same way as a hot water bath.

Let us inquire first what the effect of heat and cold is upon the body. It will be realized that the effects are produced almost entirely through the action on the skin.

**The Action of Hot Water on the Skin.**—The primary effect of a hot bath is to stimulate. This phase passes very rapidly and a secondary relaxing effect occurs. The terms stimulating and relaxing refer to the capillaries of the skin. The first effect of a hot bath is to contract them. Very soon, however, they begin to dilate, the blood pressure falls, and the pulse rate increases.

A later effect is general elimination from perspiration.

The electric cabinet or hot air cabinet has the same effect. The electric cabinet usually used can be improvised by any one in any home or hospital by having the patient in bed with hoops or barrel staves over him covered with blankets and hot air introduced through a small stove pipe from an alcohol or gas burner, or by the use of many electric globes under the small tent formed by the barrel staves and blankets. The eliminative effect of the electric cabinet is greater than the hot water or hot air bath. It seems to be more stimulating to the capillaries over a longer period than the water or air bath.

**The Effect of Cold Water on the Skin.**—The first effect of this is to contract the arterioles. The area involved, if the application is local, or the whole body if it is general, is blanched and white. Later a reaction occurs: the skin surface becomes flooded with blood and there is

a pleasurable sensation of warmth and vigor. What is the cause of this reaction? Baruch explains it by saying that the primary blanching is due to the contraction of the muscular and elastic fibers of the skin by the cold which results in pressing the blood out of the capillaries. Later when the cold is removed the muscle fibers relax slowly; the vessels relax and permit warm blood to flow into them more freely than before the bath; this warm blood further relaxes the muscles and a red glow results.

This tonic reaction is one of the important things in hydrotherapy. Some individuals do not react well, due to either weakness or disease. Baruch gives a simple test for selecting these individuals before subjecting them to the bath. "Draw the back edge of the nail of the index finger with a very gentle pressure over the skin of the chest; a pink line appears if the patient's resisting capacity to shock is good."

It is inadvisable to try to get a reaction by reducing the temperature of a bath gradually. The whole mechanism of reaction depends upon the primary shock of cold water. It may be possible in sick patients to reduce the temperature of the bath a little each day, but the primary dash of water must be such as to cause reaction each day.

## HYDROTHERAPY

Hydrotherapy is the use of water in the treatment of disease. In studying it we become sharply aware that we are entering a field somewhat different from what has gone before. Drugs, serums, diet—these are all means of treatment which any physician can use and recommend; he requires no elaborate equipment, to carry out treatment with them. But with the means of treatment which we are about to study—hydrotherapy, massage, electrotherapy, the group of things usually referred to as physical therapy—this is no longer true. They are somewhat time-consuming to do, and often require a very especial training to become adept in their use. For this reason physicians have usually neglected to learn much about them, and have been content to turn patients over to the practitioners of the various arts without much instruction or advice. They have even neglected very largely to learn the indications for the various treatments—that is what diseases will be benefited, and it is no uncommon thing to have the patient himself suggesting a course of baths or of massage.

The practitioners of these specialties—hydrotherapists and masseurs—are continually heaping invectives upon the heads of the profession for what they call the neglect of these means of treatment. This attitude, I for one, do not share. In the first place I am considerably uncon-

vinced of the great importance of many phases of physical therapy—particularly massage and electrotherapy. It has been my experience that these fall far short of the promises made for them. Furthermore when one comes to look over the list of diseases which are set down as proper for this treatment it will be seen that they are largely of two classes: either they are relatively trivial and unimportant—such as wrinkles and lumbago—or they are obviously such that the treatment can give only temporary symptomatic relief—such as arteriosclerosis, nephritis, etc.

Of all the means of physical therapy hydrotherapeutics is certainly the most valuable. It can be used for a wide variety of ailments and its effects are valuable and permanent. It certainly is one method which can be said to have been somewhat neglected by the profession.

The point of view which I shall insist on in this chapter is that *the best hydrotherapeutic procedures can be carried out in the bathroom of any house in the United States.*

**List of Diseases in Which Hydrotherapy is Useful.—**

A. Diseases in which it is the sole remedy:
- Sunstroke.
- Convulsions in children.

B. Diseases in which it is an important part of treatment:
- Typhoid fever.
- Nephritis.
- Myocardial degeneration.
- Neurasthenia.
- Constipation.
- High blood pressure.
- Functional stomach disorders.
- Insanity.

C. Diseases in which it is a helpful aid in treatment:
- Pneumonia (chest compress).
- Local inflammation:
  - Rheumatism.
  - Mastoid disease.
  - Neuralgia.
  - Abdominal pain.
  - Peritonitis.
  - Ileus.
- Scarlet fever.
- Tuberculosis.

**The Physiologic Principles of Hydrotherapy.—**

In the use of water we have three variables:

1. The temperature of the water.
2. The period of time over which it is applied.
3. The force with which it is used or directed against a part.

As we change these we may get different kinds of effects. Baruch gives four:

Tonic.
Eliminative.
Sedative.
Stimulant.

Examples of these are:

*Tonic.*—Hot air cabinet until warm avoiding perspiration, followed by fan douche, 90° F., ninety seconds, 25 pounds pressure. Temperature is reduced one degree and duration increased 10 or more seconds each day after 70° F. Friction follows. Patient goes into open air.

*Eliminative.*—Hot air cabinet, to perspire five minutes or more. Followed by circular douche, 100° F. gradually reduced to 90° F. for two minutes or longer. Jet or fan douche 95° F. Friction follows. Patient to remain in house.

*Sedative.*—a. Wet pack, 70° F. one hour in bed before retiring. If not asleep dry gently.

b. Continuous bath at 100° F. for 1-12 hours.

*Stimulant.*—Add jet douche, same temperature to tonic treatment. For local stimulation of an arm or leg use whirlpool baths at 110° or 115° F.

*Hydriatic Prescriptions:*

The prescription for hydrotherapy should be as exact as the one for a drug.

It should include:

1. Method to be employed.
2. Time of day—
   Sedative in the evening.
   Stimulating in the morning.
   No bathing within an hour after a meal.
3. Temperature and quantity of water.
4. Duration of bath and douche.
5. Pressure of douche.
6. Nature and duration of compress or pack.

7. Special form of friction or exercise ordered to assist reaction.
8. Length of time subsequently devoted to rest.
9. Number of treatments and interval.

## I. BATHS AND PACKS

### 1. The Brand Bath, the Temperature Bath, the Cold Friction Bath, Sponge Bath

In 1861, Brand, of Stettin, in a book entitled "Die Hydrotherapie des Typhus," described a method of treating typhoid fever with water which soon became generally popularized under the name of the Brand bath. The general idea of the method did not, however, originate with him. In 1798 James Currie of Edinburgh, published a book on the "Effects of Water, Cold and Warm, as a Remedy in Fever." Currie knew, from experience that in ships entering port with a large number of typhus cases among the sailors, some of the men who could not be accommodated in bunks would lie down on the deck; he found, quite by accident, that if buckets of sea water were dashed over them, they recovered more rapidly and promptly than their supposedly more fortunate companions who were safely harbored in bed. It is to be remembered that "typhus fever" was a generic term which included typhoid and probably the larger number of the cases which Currie saw were typhoid. His book, based upon the development of his experience is one of the triumphs of observational medicine of the generation of Jenner, Withering, Huxham, Fothergill and Baillie.

The Brand bath, the technic of which will be described below, deserves our most careful consideration. Fundamentally it can be applied not only to the treatment of typhoid fever but to the treatment of any fever. In the synonyms given for it above I have put down "temperature sponge," and "cold friction bath." These contain respectively the gist of its indications and of its technic.

Before describing the technic, let us try to get an idea of what we intend to accomplish. What is the action of a cold bath in fever?

Its most important action is not that it reduces temperature, but that it is *a cardiovascular tonic*. No drug in the world is so valuable as a stimulant to the heart, and as a tonic to the blood pressure as is the proper application of hydrotherapy. The profession, whether it knows this or not, is certainly chary of mentioning it. In a recent article on the heart in pneumonia, written by two eminent physicians of this country, there is a thoughtful and wise review of the treatment of cardiovascular failure in pneumonia, and, by implication, in other acute infectious diseases. Not one word, however, is said about any hydro-

therapeutic measure. So far as a sudent, coming to that paper with no previous knowledge of the subject, would know there is no such thing as the therapeutic use of wet packs or friction baths in cardio-vascular failure.

In the second place the bath is a *general tonic to the nervous system.* The word tonic is not quite the proper one. Its action is to restore the nervous system to normal; it induces sleep in lesser degree, or mental quiet in restless, apprehensive patients, tortured by the drain of continued hyperpyrexia. Often the typhoid patient who has previously been tossing from side to side, will fall into a long refreshing sleep under the influence of the bath.

Third, it is *an eliminant.* The secretion of urine, the most important medium for the excretion of nitrogenous by-products of metabolism, is increased. Perspiration is induced. The bowels are often stimulated to evacuation, and the superiority of this method to the use of drugs is, at least partially, due to the fact that with the method of the bath, the constitution does not have the additional burden of the excretion of the drugs themselves.

Lastly, but purely as a by-product of its action, *it reduces the temperature.*

As to the technic we must consider first the original Brand bath. This is always given in a tub. In typhoid fever the *indication* is a temperature of 103° F. or over. Note that while the primary action of the bath, and its greatest value, is not the reduction of temperature, the indication for its use is the height of the temperature. In most medical cases—pneumonia, and scarlet fever—the figure of 103° F. will stand, but in surgical cases 102° F. is usually the indication.

*Technic.*—1. *Keep relatives out of the room.* The patient usually protests against the bath, his teeth chatter, his finger nails turn blue. There is often quite a good deal of trouble in quieting his apprehensions, and it is unnecessary to add to these difficulties the importunities of sympathetic members of his family.

2. *Temperature of the Bath.*—From 70° F. to 80° F. depending upon the severity of the case and the general condition of the patient. It may be well to begin the first baths with the temperature of 80° F. and reach the lower temperature, even to 60° F., later.

*The tub* three-fourths filled should be rolled near to the bed and the patient lifted gently into it. A handkerchief is wrapped around the patient's head and water at 60° F. poured over him.

3. *Friction* should be begun immediately. It is quite as important a part of the technic as the bath itself. The attendant or nurse should

rub or stroke gently the legs, arms, chest, back and upper abdomen, until the primary pallor of the skin is replaced by a diffuse glow.

4. *The length of the bath* is usually given at 15 minutes. It should depend somewhat on circumstances. The bath should not be stopped because the patient complains of chilliness, nor because there is some moderate chattering of the teeth. Cyanosis of the finger tips is not alarming, because the hand, being submerged, shares in the general constringing effect of the cool water. Cyanosis of the lips or face, however, is an indication for stopping the bath. A very rapid weak thready pulse, even without cyanosis of the face should cause the attendant to stop the bath and put the patient back to bed.

5. *After-treatment.*—While the bath is going on the bed should be arranged. A double blanket is spread over the regularly made bed and an old linen sheet placed over the blankets. After the bath the patient is put, without drying, on the sheet and wrapped up in it, the blankets being folded over him for a few minutes. If his temperature was 103° F. before the bath he may be left wrapped thus for some time. If not he should stay only a minute or two and then be dried immediately.

### 2. Substitutes for the Brand Bath

The patient often is averse to the Brand bath. Some like it, most do not. Partly for this reason and partly because it is a good deal of trouble to provide a portable batl tub, it has fallen into disuse in its original form, and various substitutes have been made for it. This is a great pity for none of the substitutes are nearly so effective as the originally described bath. However the principles which govern them are the same.

The one most commonly used is the *sponge bath.* The technic is as follows:

1. Take temperature, pulse and respiration before and half an hour after the sponge.
2. Ice cap to head and feet.
3. Expose only the area bathed.
4. Use mild friction. Do not use pressure on the abdomen.

**Articles Necessary.**—

1. Large rubber sheet.
2. Two bath blankets.
3. Bath towels.
4. Wash cloth.
5. Hot water bag.

6. Ice cap.
7. A basin of water, temperature 70° to 80° F.
8. Pitcher of cracked ice.
9. Alcohol for rubbing.

**Procedure.—**

Protect bed with rubber sheet and put patient between bath blankets.
Ice cap to head, heat to feet.
Remove gown.
Place cold compresses under axilla and change often.
Sponge face and neck and dry gently.
Place wet towel over abdomen and chest and change often.
Expose and bathe extremities using gentle friction.
Apply alcohol to each part as bathed.
Bath should cover a period of 30 minutes.
Remove blankets, leave cold to head and heat to feet.
Replace gown and bedclothes and make patient comfortable.

The *slush* is really more effective than the sponge bath, but not so often used because it is sloppy and troublesome. It is given by forming a trough in the patient's bed with a rubber sheet, built up around the sides with sand bags; a drainway into a receiving bucket must be provided. The patient laid on this is sprinkled from a watering can containing water at the temperature of 70° F. or from a sponge squeezed out over him. The slush is practically an affusion.

### 3. The Wet Pack

In most acute contagious diseases, the wet pack is secondary only to the Brand bath as the most effective single remedy we have, not only for the support of the heart and vascular tonus, but also for the general detoxicating and eliminative action and the comfort of the patient. In the bronchopneumonia of influenza, it is, in my opinion, the only reliable heart tonic we have. In lobar pneumonia and scarlet fever it is equally effective.

It is a splendid remedy for insomnia.

The technic is as follows:

**1. Preparation of the Bed.**—The bed should be narrow. A rubber sheet is placed over the mattress. Two large woolen blankets, which reach a foot or more beyond the patient's extremities at the end, and to the floor on the sides are laid over this.

A linen sheet wrung out of water at the temperature of 60° to 70° F. (as the severity of the case requires) is placed on the blankets.

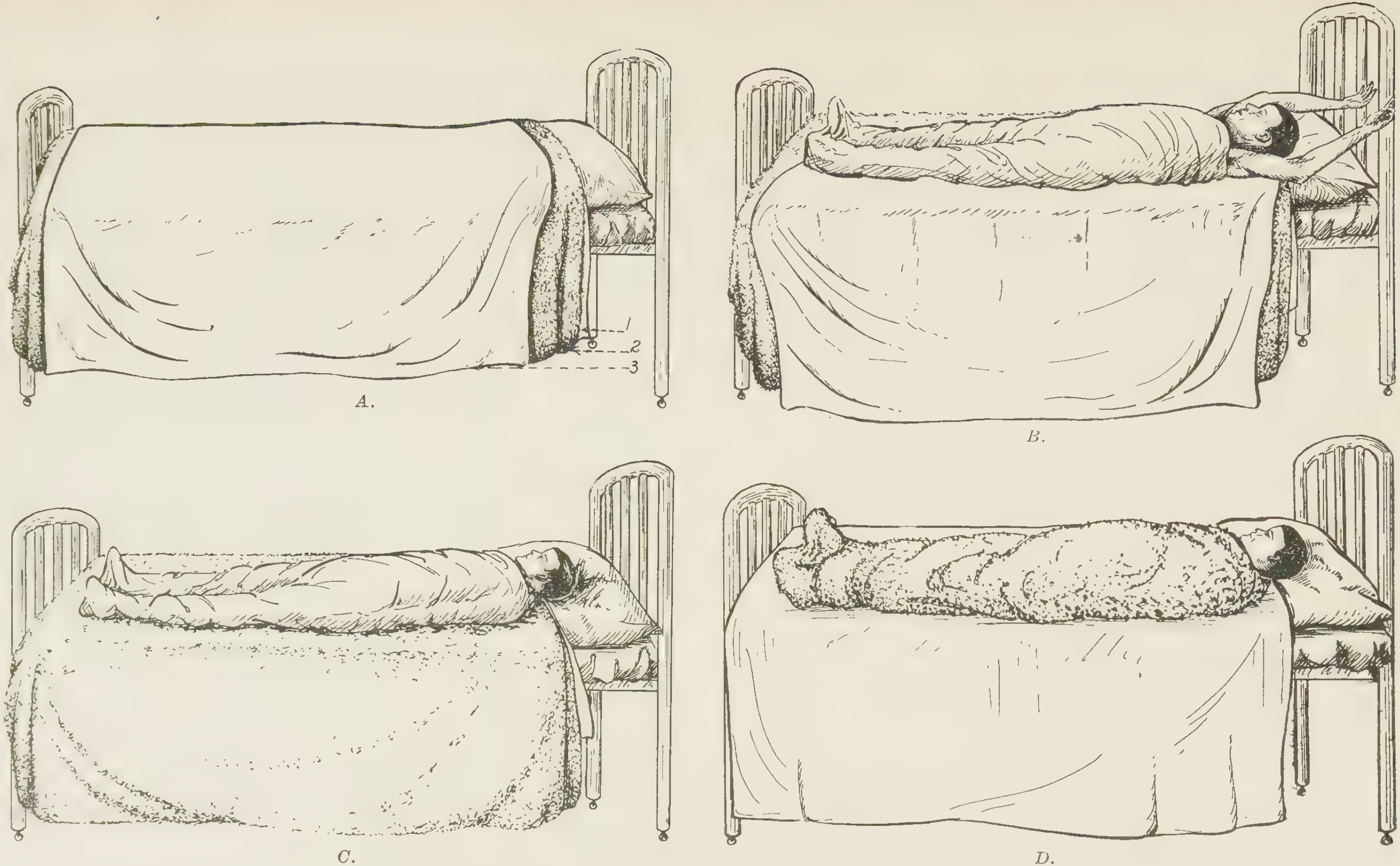



Fig. 27.—The wet pack—one of the great remedies in therapeutics.

*A.* Arrangement of the bed before the patient is placed on it. (1) A rubber sheet over the mattress; (2) two woolen blankets, which reach nearly to the floor on the sides and at the end; (3) a linen sheet wrung out of water at the temperature of 60 or 70° F.

*B.* The patient is laid on the wet sheet, and his arms extended; one-half the sheet is brought across his body, and pushed down between his thighs and legs.

*C.* The arms are now brought to the sides and the other half of the sheet brought over them and over the body.

*D.* The blanket is wrapped securely around him closely in at the neck. Afterwards the second blanket is put over him.

**2. The Patient Is Laid on This Sheet.**—His arms are raised and one side of the sheet is drawn from left to right over the body, and pressed between the legs.

The arms are lowered and the other side of the sheet brought over the body and the arms. The arms are thus separated from the body by a layer of sheet.

The first blanket is brought over the patient's chest, tucked under the chest and reversed over the clavicle, then brought over the body and tucked in all along the body and legs.

This procedure is repeated with the second blanket. The patient must be wrapped airtight in the blankets from neck to feet.

**3. Duration of the Pack.**—From one hour to one and one half hours for febrile cases. For insomnia the patient remains in the pack as long as asleep.

It will usually be necessary to overcome the prejudice of the patient and his family to damp sheets before the wet pack can be carried out. The physiology of it, however, is clear. The first effect of contact of the skin with the cold sheet is a contraction of all the cutaneous vessels. This continues until the period of reaction, which occurs in every instance following the application of cold to the skin as described in the first part of this chapter. It is not furthered in the wet pack by friction as it is in the Brand bath, but depends upon the patient's own powers of reaction. Thus the wet pack should be used with some selective thought for the patient's age, vigor and strength. When the cutaneous vessels begin to dilate, there is a rapid circulation and interchange between the cool blood at the surface and the warm blood of the interior of the body, in an effort to equalize the difference in temperature between the sheet and the body. This amounts to a cardiovascular massage, and is the secret of the value of the wet pack. The exchange of heat causes a gradual vaporization and heating of the moisture in the sheet, and a consequent formation of a layer of warm vapor over the patient's body. The patient is virtually lying in a warm bath, and experiences the same soothing effect. A perspiration forms on his face; he goes to sleep. When the sheet is removed it is moist with warm perspiration.

### 4. The Hot Wet Pack

**Indications.**—

a. Nephritis, uremia, toxemia of pregnancy, for its general eliminative effects.

b. Convulsions of children for its soothing effect. It is as good as the hot bath for this.

**Technic.**—This is the same as that of the wet pack except that the temperature of the water is 110° F. or more. A light blanket may be used instead of a sheet and is preferable. It is wrung very dry out of scalding water. The light blanket is preferable to the heavy blanket because it can be wrung dryer, and the danger of scalding the patient is eliminated. An ice cap or towel wrung out of cold water is placed on the head and the patient encouraged to drink water during the bath. The hot pack should last from 20 to 50 minutes.

### 5. The Continuous Bath

**Indications.**—

a. Insanity of various kinds. The continuous bath is being more and more used in psychiatric institutions.

b. Skin diseases. Pemphigus, psoriasis, dermatitis exfoliativa, etc.

c. Bedridden cases, compression myelitis, etc., in danger of bed sores.

**Technic.**—A bath tub filled with water at the temperature of 100° F or thereabouts, the patient immersed and the tub covered with a canvas lid or a sheet. As to duration—the word continuous covers that. One of Hebra's patients stayed in a bath a year and gained 14 pounds.

### 6. The Sitz Bath

In this bath, for which a special tub is usually used, the hips and lower abdomen are immersed in hot (sometimes cold) water. It is used in menstrual disorders, bladder irritability, rectal disease and prostatic disease.

### 7. Sweat Bath, Hot Air Bath, Electric Light Cabinet, Turkish and Russian Baths

Various forms of sweating baths have been employed by medical men since the days of Hippocrates. In Japan the custom of taking baths in almost scalding water is so common that it is estimated that a Japanese will often take four or five hot baths a day. In India, Hinsdale states that the English have had to modify their bathing habits; they found that a hot bath made them better able to endure the hot weather than a cold bath, because the cold bath stimulated the heat producing centers to activity.

Therapeutically hot baths for the purpose of inducing sweating are more often given with hot air than with hot water.

One of the best known forms of sweating bath is the Turkish bath. In large cities where such establishments are common Turkish baths are frequented by individuals who go to them without medical advice, and

usually with symptomatic benefit. The "patient" in a Turkish bath is carried through four rooms. In the first room the temperature is carried by dry heat up to 110° or 130° F.; the patient stays here twenty minutes. In the second room, where he stays only a few minutes, the temperature is 150° to 200° F. In the third room he receives a massage and if desired a salt rub and in the last room has a cold shower.

In practice a good sweat-bath can be given to a patient in bed, by putting hoops over him, covered with a blanket and allowing the hot air to be introduced under this tent by way of a tin pipe at one end of which is a lamp. Even better is the use of electric light bulbs or cabinets, such as can be used over sore and inflamed joints.

Patients who are not in bed can be best sweated in hot air cabinets or what has everywhere superseded the old fashioned hot air cabinet—the electric light cabinet. This is a box, in which is placed a stool for the patient to sit on; the cabinet is provided with doors which enclose him allowing the head to be outside. The inside of the cabinet is lined with mirrors and electric bulbs. When the patient is inside and his head is bound with a towel wrung out of cold water, the lights are turned on; profuse sweating is induced in about fifteen minutes. Dr. Baruch thus sums up the advantages of the cabinet bath over the Turkish bath:

"The superiority of the hot-air cabinet over the ordinary Turkish bath is evident. The patient is surrounded by hot air in the cabinet and, the head being free, he breathes cooler air. Not only is he thus enabled to bear higher temperatures, but he is free from dyspnea, which is so distressing to many in the hot-air chamber of the Turkish bath, and which is doubtless due to a defective supply of oxygen; the latter, being expanded by heat, is not breathed in sufficient quantity to fulfil its physiologic function. If oxidation be the chief object of the hot air bath, the cabinet bath must be far superior to the Turkish bath, because it permits a more abundant supply of oxygen as regards the temperature, and thus facilitates oxidation. Besides, the patient is not subjected to the admixture of emanations from the large number of persons who often occupy the hot-air chamber simultaneously in the Turkish bath establishments."

The electric light cabinet seems to be more effective than the steam pipe hot-air bath. The effects of the light as well as the heat are stimulating and seem to induce more profuse perspiration.

The sweat bath is used in many clinical conditions. In nephritis it is supposed to be helpful by providing a means of excretion. There was an old theory of Traube's that uremia is due to edema of the brain, and the recent water intoxication experiments of Rowntree have

given this a new impetus. The excretion of water alone, to say nothing of salt and urea seems to be enough to account for the unquestioned clinical benefits that result from sweating in impending uremia and in nephritis.

In hypertension, whether associated with manifest nephritis or not, the sweat bath will reduce the blood pressure both systolic and diastolic. The reduction will continue for several hours, although there is a slow return towards the previous readings.

## II. THE AFFUSION

**Technic.**—Affusion is usually given with the patient sitting in an empty bathtub. The bottom of the bathtub is covered with a bath towel. A bucket or pitcher of water at the temperature of 60° to 80° F. (depending on circumstances) is poured over the back, the chest, and the legs of the patient from a height represented by the upraised arm of the attendant emptying the pitcher of water.

The affusion may be given to the patient in bed.

**Indications.**—Tuberculosis, anemia, neurasthenia, fevers.

The affusion is one of the best general tonics at the practitioner's command. The simplicity of its technic has caused it to be neglected. It is a most valuable adjunct to the treatment of tuberculosis or any anemic state or condition characterized by loss of tone or resistance.

The affusion is not at all the same as a cold bath, and not quite the same as a cold shower. The shock caused by the broad stream of cold water hitting the skin is the secret of its effectiveness. The temperature of the water may be suited to the patient's strength. In the weaker patients it is well to begin with warmer water and at later treatments reach the colder levels.

### Treatment of Sunstroke

The treatment of sunstroke is so particularly a hydrotherapeutic procedure that it is proper to treat it here in detail. In Osler's "Practice of Medicine" under the heading of "Treatment" in the section on "Sunstroke" are two sentences: "In thermic fever the indications are to reduce the temperature as rapidly as possible. This may be done by packing the patient in a bath with ice."

This state is considered inadequate by Dr. Baruch (see reference). He points out that in four New York hospitals during August, 1895, there were 520 hyperpyrexia cases and 132 deaths, and he analyzes these results with great profit. Note the variations in technic compared to the mortality.

At the Brooklyn Homeopathic Hospital there were 49 cases with a mortality of 41 per cent. Tub baths were used beginning with the water hot (110° F.) and gradually lowering it to 72° F.

At Bellevue Hospital, where the ice bath was used, as advised by Osler, the mortality was 33.3 per cent.

At the Flower Hospital the mortality was only 11.5 per cent. The treatment consisted in placing the patient, with an ice cap on his head, on a cot and sprinkling him with tap water at a temperature of about

Fig. 28.—The affusion. This is one of the best remedies you can use in asthma and in anemia, and such undernutrition states as tuberculosis, enteroptosis, and neurasthenia.

70° F. If the temperature fell to 103° F. he was wrapped in blankets; if the temperature rose again to 104° or 105° F. he was again sprayed.

At St. Vincent Hospital 197 cases were treated with a mortality of 6 per cent. Evidently the treatment here was most successful. They had at once the largest number of cases and the smallest number of deaths. The patient was wrapped in a sheet and placed on a cot which had been covered with a rubber blanket. Dippers full of cold water were dashed upon him from a distance of several feet. Every two or

three minutes a stream of ice cold water was poured on his head from a height of 6 or 8 feet. When the temperature fell to 103° F. he was wrapped in blankets and surrounded with hot water bottles.

From these statistics we may gather that the gradual reduction of temperature, by putting the patient in a hot bath and then a cooler one, etc., is the worst form of treatment; and the sudden reduction of temperature by putting him in an ice pack or bath at about 40° F. is the next worse.

As in other hydrotherapeutic procedures we find that there is great advantage in stimulating the cardiovascular system by the force of the stream of water. The wrapping of the patient in a sheet upon which the water is dashed, does not allow of a too sudden withdrawal of the heat from the body surface, which seems to be the weak point in the ice bath. In sunstroke there is not only hyperpyrexia but a vasomotor collapse, especially paralysis of the cutaneous vessels. They need to be stimulated to contraction, and the warm blood cooled and sent into the interior and yet not so violently that they cannot dilate again to receive the displaced volume of internal blood heated to high temperature. In an ice bath or pack the cutaneous area is made pallid, showing that the cutaneous muscles are contracted, all the blood squeezed out of them, and thrown into the already overburdened heart. Neither is the temperature mitigated so that they once more dilate.

The objection to giving the very hot bath as the first step seems to be that it causes increased paralysis of the cutaneous area with a consequent prolonged upset in the heat regulating center. While a vigorous individual, or an athlete may find benefit in taking a hot bath followed by a cold one, it must be remembered that his vasomotor tone and cardiac tone are good, whereas the patient's with sunstroke is poor. Thus the subsequent application of cold water does not result in the usual "reaction."

## III. THE LOCAL APPLICATION OF HEAT AND COLD—COMPRESSES, FOMENTATIONS, ICE COILS, ICE CAPS, HOT WATER BAGS, ELECTRIC PADS, STUPES

These measures, some of which constitute the commonest domestic methods of treatment, all depend for their value upon the action of heat and cold. Applied locally for local pain or inflammation they seem to act in three ways.

Let us take the simplest case first. The accompanying diagram (Fig. 29), modified from Lauder Brunton's little book on the "Therapeutics of the Circulation," will help us. A local infection—boil or felon—in

an extremity is a very painful thing. Every one knows how the pain will yield to immersion in hot water, or to a hot compress over it. Some people find more relief from cold water, and this difference in individual taste can be followed throughout the application of the method: some patients want a hot water bag on the mastoid, some an ice coil and so on. The action of the heat and the cold in the long run is the same. The spot of infection at the end of the finger draws about it a ring of dilated vessels filled with blood. The area gets hard and indurated and the sensory nerves in the neighborhood are pressed upon and cause pain. The application of heat soon dilates the superficial vessels away from the immediate site of the inflammation and the pressure is relieved. The active interchange of blood—the hyperemia of Bier—also causes more rapid resolution.

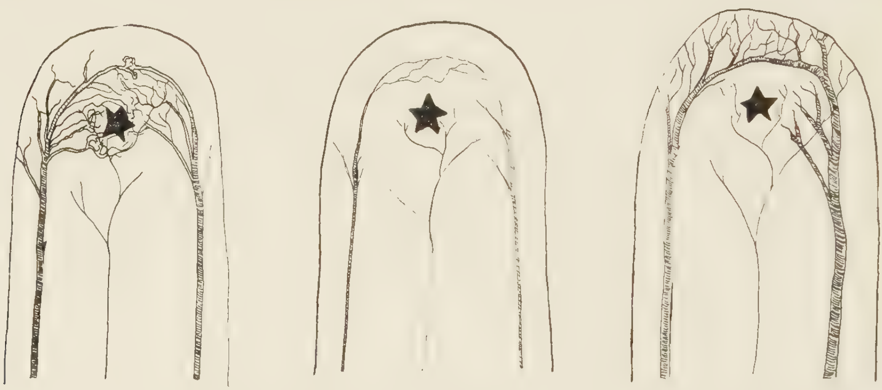


Fig. 29.—Lauder Brunton's diagrammatic illustration of the effect of cold and hot compresses upon a localized inflammation.

All pain which is relieved by heat and cold is, however, not inflammatory in origin. Neuralgia, myositis, "muscular rheumatism," sciatica, lumbago, are all helped. Part of this action is due to the soothing effect that heat and cold has upon the sensory nerves. The depth of penetration of heat by these simple measures is greater than we are accustomed to believe. Macleod and Taylor report experiments with rabbits. Application of heat to the surface of the thigh caused a rise of temperature in the tissues for a distance of three-quarters of an inch into the underlying thigh muscles, as recorded by thermocouples buried in the flesh. Applied to the abdomen, heat at about 25° F. more than the skin surface, caused temperature changes to be recorded three inches below. It is pointed out that the rise in temperature is due to actual penetration of the tissues by heat and not by vasodilation because the temperature achieved is much higher than that of the circulating blood. Cold applications responded at much the same distances. It was not

possible to cause much change of temperature of the kidney and liver, by hot or cold applications on the skin. But the brain was considerably affected, as was, presumably, the skull, an important fact in connection with the mastoid coil. When cold was used the temperature of the brain fell very markedly: when the applicator was 45° F. below that of

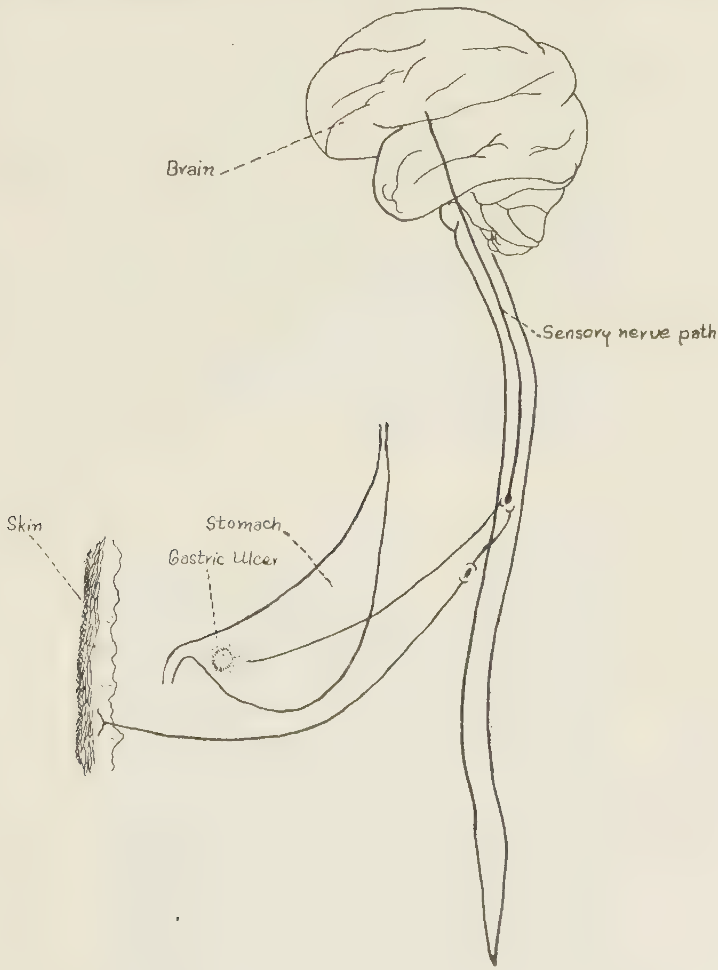



Fig. 30.—Diagram to illustrate the mechanism of the value of counterirritation in gastric ulcer.

the body the temperature of the brain at a depth of ⅔ of an inch fell 6 degrees.

There is, however, another effect which we must consider. Sir James Mackenzie, in one of the most stimulating little books written in our generation, tells a story of a consultation over a case of gastric ulcer. The pain of which the patient complained was located in the epigas-

trium in a spot the size of a dollar. Sir James proposed the question to his consultant as to where the ulcer was in reference to the spot of pain. The consultant stated that if one thrust a hat pin through the center of the spot of pain directly into the body the pin would eventually go through the center of the gastric ulcer. Sir James disagreed with him: he pointed out that in some cases of ulcer the stomach was dropped, and the ulcer bearing area might be below the umbilicus, but the pain remained in the epigastrium. He explains this in his book, by saying that the sensory nerves of various viscera—for instance, the stomach—have certain definite areas of termination in the cord, after passing through the sympathetic plexuses, and impulses going there stimulate adjacent areas of sensory termini from the skin, so that pain from a viscus is referred to a definite area of the skin surface. (Fig. 30.)

Taking this over into the region of counter irritation, we know that heat or cold applied to a skin surface, made painful by the disease of its analogous viscus, relieves the pain. Our only explanation of this is that the heat or cold, by sending stimuli through the sensory nerves in that spot, affects the area of irritability in the spinal cord and perhaps causes some vasomotor change, by contact, at the site of inflammation in the viscus. There is no other adequate explanation of the undoubtedly helpful effect of such counter irritative measures as mustard plasters, hot water bags, ice bags, etc.

We append below the technic of certain hydriatic local applications. The use of such things as hot water bags, ice bags, electric pads, electric light heat locally, etc., is so simple as to need no explanation.

### 1. The Compress

**a. The Priessnitz bandage** is a good starting point to study the action of compresses. Vincenz Priessnitz during the early part of the nineteenth century became famous in Austria and some other parts of Europe for his cures by the use of water. He was an uneducated farmer to begin with, but he travelled widely during the years of his fame, treating the great and the rich for all manner of ailments, with considerable success, to the disgust of the regular profession.

Among his methods was the Priessnitz bandage. It is used largely in abdominal complaints. The technic is simple in the extreme. A double piece of linen—an ordinary linen hand towel—is wrung out of cool water and laid on the abdomen, usually at bedtime. A larger, thicker piece of linen—a bath towel—is brought around the abdomen over it—like a binder and pinned there to hold it in place. The patient usually wears it all night.

*A.*

*B.*

Figs. 31-*A* and *B*.—Technic of the application of the throat compress. Note that the bandage goes over the top of the head, not around the neck.

The amount of relief obtained with this is out of all proportion to its ease of application. In many cases of gall bladder affection it equals a dose of morphine. It is valuable for the pain of gastric ulcer and of intercostal neuralgia and pleurisy. That it is not used more is largely due to the profession's failure to realize its efficiency, the result of being misled by its simplicity.

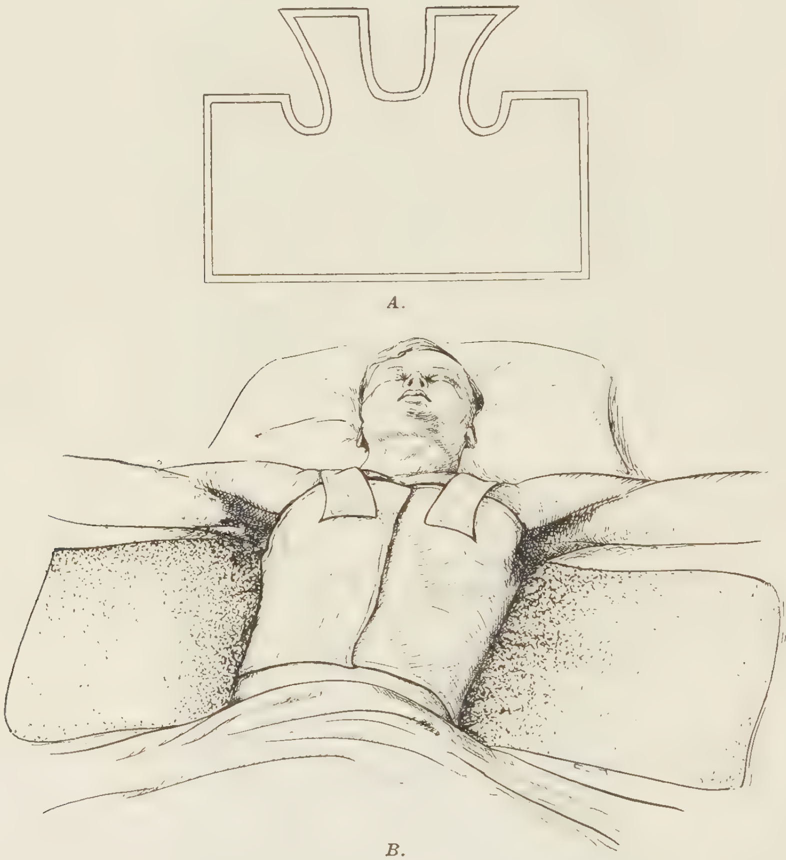



Fig. 32.—The chest compress. *A.* Pattern for cotton or flannel folder to cover chest. *B.* Compress in place, flannel folder in place for cover.

**b. The Throat Compress.**—*Indications.*—Laryngitis, tonsillitis, etc.

*Technic.*—Two strips of linen three inches wide and long enough to reach from one ear to the opposite ear, and a strip of flannel three and a half inches wide and long enough to go around the chin and over the top of the head. The linen strips are wrung out of water at 60° F., and placed on the throat from ear to ear covered by the flannel which is pinned over the top of the head, and allowed to remain an hour when a fresh one is put on.

**c. Chest Compress** (Fig. 32).—*Indications.*—Pneumonia, severe bronchitis, pleurisy, etc.

*Technic.*—Two or three pieces of linen are cut in the shape of a chest pad or pneumonia jacket (see Fig. 32*A*). A flannel covering is made in the same shape. Several of each of these should be on hand for the same patient.

The linen jacket is wrung out of water at 60° F. and placed on the chest, covered snugly by the flannel protector. It should be changed every hour or half hour, unless the patient is asleep, and a fresh one should be in readiness to put on as soon as the old one is taken off, in order not to expose the patient unnecessarily. This explains the necessity for having several made for each patient to begin with.

*Caution.*—Nurses should be warned not to cover the compress with rubber or oiled silk. This, as Dr. Baruch points out, would convert the compress into a poultice or wet dressing and would destroy the idea of it, i.e., the stimulation by thermic excitation, then hyperemia by reaction, and finally the slow reduction by evaporation through the flannel. This also applies to the abdominal or Priessnitz compress.

**d. Joint Compresses.**—Joint compresses may be used for arthritis and painful periarticular disease. They are applied by the same technic and on the same principles as the other compresses.

### 2. Fomentations or Hot Compresses—or Stupes

Dr. Hinsdale in his many valuable writings upon hydrotherapy has so often quoted Dr. Curran Pope's account of the application of a hot compress that I also feel justified in doing so:

"I will now simplify my apparatus by limiting it to a basin, two towels, and a tea-kettle filled with *boiling* water. The majority of hot applications fail for two reasons. In the first place the application is *too wet*, and in the second the hot application is *too cold.* Hot applications should range anywhere between 125° and 165° F. (51.7° and 73.9° C.). You cannot handle them with your hands, in fact, they are too hot for you to pick up and hold at all. If you put these applications on the patient's skin *too wet* they blister. If you put them on only warm you lose two-thirds of the benefit of the treatment.

"Suppose that we are going to make a hot moist application or fomentation to the pelvis, where we want all the heat we can get. It is best to use a Turkish towel or a small piece of blanket. If you can't get that, get a piece of an old flannel petticoat. Take this and place it right in the center of your towel. Now you have everything ready, and the

mistress of the house brings in the tea-kettle full of boiling water. If you were to place it on the patient without previous preparation, you would burn her. Place around the hips, pelvis, and lower abdomen a folded blanket, so applied that the ends overlap in front. Now rub the surface to be covered by the fomentation with vaselin. This prevents maceration or softening of the superficial epithelial layers. Having poured the boiling water over the flannel that lies in the towel, so hot that you have to keep back, two persons commence twisting the opposite ends of the towel and keep twisting until all or nearly all the water has been removed. We have in this towel, we will say, a piece of flannel at a temperature of 165° F. (73.9° C.), and what does the nurse now do? She picks up the towel containing the flannel, goes to the bedside, rapidly unrolls the towel, and places the hot flannel in place upon the bare skin. If the patient howls, lift it up for a second, and then put it back again. Just as soon as the patient can *tolerate* the high temperature, the fomentation is covered by the blanket, which is pulled as tight as possible to prevent the entrance of the air. There is very little risk of burning if plenty of vaselin has been used.

"Usually in less than sixty seconds you will get a relief that can be gotten from no other application that I know of.

"These two procedures any doctor can use. It does not make any difference where he is or how he is situated."

**A turpentine stupe** is given in much the same manner as the hot compress. The skin is smeared with vaselin, two layers of flannel are wrung out of boiling water, *in which turpentine is added one dram to a quart.* The turpentine may be left out of the water and sprinkled on the flannel after it is in place.

*Indications:* Both the turpentine stupe and hot fomentation are used with value and comfort to the patient in many abdominal and pelvic conditions—ileus, gall bladder disease, distention, postoperative gas formation, etc.

### Local Application of Heat and Cold

Local pain, injuries (sprains) and inflammation particularly in joints and muscles are so frequently treated by heat and cold, applied in the form of hot bricks or hot irons, hot water bags, ice bags, ice coils, etc., as not to require any description. They give so much relief that he would be a poor physician who would ignore them.

The mastoid coil, or ice bag, in mastoid disease is so essential a part of the early treatment of mastoid disease that every physician owes it to his patient to use it.

The use of small electric cabinets and of bake ovens for arthritis of knee, ankle, elbow and wrist, and for sprains and injuries, most undoubtedly results in something helpful although we cannot say exactly what it is. Such physiologic explanations as those usually given of them, particularly by manufacturers of the apparatus, break down under critical examination. But the patient's testimony remains—the pain is eased, the part gets well quickly. These treatments are all the more helpful when accompanied by skillful massage.

**Counterirritation.**—There seems to be a definite, though, as yet, not clearly worked out, distribution of mass volumes of blood in the body, the vessels in one part of the body being contracted while the vessels in another part are engorged. These phenomena can be influenced by hydrotherapeutic measures. For instance, I have seen the feet get warm from the application of ice to the dorsal spine. Again it is an old custom to apply a cold key to the back of the neck in nose bleed; orthodox physicians scoff at it, but then scoffing at something you don't understand is also an old custom. Winternitz says that cold applied to the feet influences intracranial circulation chiefly; to the thigh, pulmonary circulation chiefly; to the back, the vessels of the nose chiefly.

One illustration of this action is the use of cold affusions to the back in bronchial asthma, due to nasal reflex. It is advised that it be poured under a pressure of 10 to 12 pounds and for only a few seconds. "The same effect is not produced by the application of cold elsewhere on the body or by mere cloths wrung out of hot water. The mechanical stimulus of the poured water seems to be the important element in the relief experienced." (Hinsdale.)

Again the *mustard foot bath* in headaches, and conditions of lowered vitality, in coryzas, rhinitis, etc., may have a rational explanation on this basis. In preparing the bath the mustard must be placed in a little cool or lukewarm water first, and the hot water added later, as the hot water first applied will not extract the essential oils from the mustard. A teaspoonful of domestic mustard tied in a muslin bag may be allowed to soak in a quart of cool water; when the patient is ready a gallon of water at 110° or 115° F. may be added. Remember that the feet are more sensitive to hot water than the hands.

## IV. ENEMATA

An enema is not a douche of the lower bowel. It is a method of emptying the colon. It is usually spoken of as if it were designed simply to flush fecal matter from the rectum and sigmoid. It does, of course, do this. But, properly given, it also empties a much longer stretch of

bowel than the water itself reaches. Its action depends upon the fact that any stimulation of the lower bowel, the rectum and anal region, particularly, causes peristalsis of the entire colon. This stimulation is caused first by the distention of the rectum, and also by the temperature of the water. In cases where there is an accumulation of fecal material in the rectum, the simple soap suds enema removes this, but such cases are comparatively rare.

*The technic of an enema* is so familiar as hardly to require description. The general practitioner, however, especially in rural districts should be familiar with it; he may be asked at any time to describe it, by some member of the patient's household; the young graduate, used to turning so many matters of technic over to a nurse, may find himself in an embarrassing situation. A simple enema usually consists of the injection of water and soap suds at a temperature of 100° to 110° F.; the amount of water required is from three to four pints. An enema bag, douche can or funnel is provided, attached to a rubber tube at the end of which may be a hard rubber nozzle or a catheter of stiff soft rubber. It is well anointed before introduction into the rectum. The best position for the patient for an enema is the knee-chest position. If this is not advisable he is put on his left side. The nozzle is introduced and the water allowed to flow in at first slowly. Soon after the introduction of the first amounts of water the patient is likely to complain of cramping and desire to empty the rectum. This is the effect of the stimulation referred to above. The flow may be stopped a moment and then continued, until the full amount has been introduced. The patient is instructed to hold the enema in the bowel as long as he is able.

For an infant an enema may frequently be necessary. A small catheter is used, attached either to a funnel or douche bag. The baby will need to be completely exposed, and the procedure must therefore be carried out in a warm room; it is never safe to run the risk of chilling the surface of a baby's body. The baby is put on the left side, the legs drawn up and the enema given as for an adult. After the catheter is removed, the baby is put on a suitable vessel, covered with blankets and held on the lap until the enema has been expelled.

The high enema or high colonic irrigation is supposed to be given with the tube pushed past the sigmoid into the colon. As Soper has shown this is seldom possible; he inserted colon tubes, injected them with barium and took x-rays; he found that the colon tubes curled up in the rectum. Colonic irrigation may be given with a large tube, shutting off the water and allowing it to run as may be necessary. In this way rather high places may be reached and cleansed. Silver nitrate and other drugs may be introduced in this way.

### Medicated Enemata

**1. The Oil Enema** is given for chronic constipation of the dyschezia type. Olive oil or cotton-seed oil is used. The oil is injected with a special syringe, (Robert's enemator can be recommended also), a Goodyear hard rubber syringe No. 65, with a curved tip. The patient with this syringe can inject the oil himself, by squatting slightly, putting the syringe between his legs, inserting the tip with the syringe up and emptying the syringe slowly. From ½ pint to a pint of oil is injected. It is usually done at night and retained all night. If it is found that it cannot be retained with comfort all night, it may be given in the morning instead.

**2. Olive Oil and Turpentine Enema.**—One-half ounce of turpentine to 4 ounces of warm olive oil mixed well. This is introduced into the rectum first, and followed with a soap-suds enema. If the oil and turpentine were put into the enema bag with the water they would float on top of the water and never get into the rectum.

Turpentine may also be given in an enema by beating with a knife 2 drams of turpentine into a pint of hot soap-suds.

**3. Starch Enema—Soothing Enema.**—Boiled starch the consistency of cream, temperature of 100° F. (adding a few drops of laudanum if desired) introduced in the usual way.

## V. SPECIAL HYDRIATIC PROCEDURES

I shall describe briefly a few hydriatic procedures which require special apparatus or a hydriatic institute.

### 1. The Nauheim Bath

At Bad Nauheim in the Grand Duchy of Hesse near Frankfort, Germany, a system of baths, the essential feature of which is the presence of carbon dioxide in the water, was, for many years before the World War, used for cases of heart disease, largely myocardial failure. They were used in conjunction with a system of resistance exercises, devised by the brothers Schott which attracted to Nauheim thousands of patients with heart disease.

The benefits described from the baths and the exercises caused the artificial form of Nauheim bath to be introduced and extensively used in this country. Dr. J. H. Pratt of Boston in the early years of the century set up a place for the administration of these baths. Dr. Philip King Brown in San Francisco and Dr. Ellsworth Smith of St. Louis were

among other pioneers in the use of the bath in this country. Several firms sell packages of salts for the production of artificial Nauheim baths. (Triton Salts, Schiefflin & Co.)

It is claimed for the baths that they cause a shrinkage of the area of the heart dullness; in other words, they benefit dilatation. They raise the blood pressure slightly and Dr. Phillip King Brown believes they are of benefit in palpitation and cardiac arrhythmias. They have been extensively attacked, probably the most eminent and unsparing of their critics being Sir James Mackenzie, who says bluntly that he never saw any patient benefited from going to Bad Nauheim. The truth of the matter seems to be that they are of value in the milder forms of cardiac failure—what might be called fatty heart and postinfluenzal heart, etc., and are of decided value in the cardiac neuroses.

The technic of the baths depends upon a graduation in the series as to strength of the mineral salts, temperature and duration.

"It is best, more especially with severe cases," says Dr. Schott in his monograph, "to commence with a simple salt-water bath. Since the water at Nauheim contains between 2 and 3 per cent of sodium chloride and as much calcium chloride per thousand, it may be necessary to dilute this still more. The duration at first should not exceed 8 or 10 minutes, in severe cases not over 5. The temperature should commence at 93° to 95° F. (33.8° to 35° C.), and should be reduced but slightly during the first week. One must be specially careful with anemic and weak patients, and with those who are easily chilled. On the other hand, however, even in patients with weak, rheumatic hearts, one should not exceed a temperature of 95° F. (35° C.), since a tonic action on the heart will not be gained. It is therefore, preferable to administer cooler baths, and to make them of shorter duration. In the first half to one minute the patient, while remaining quiescent, may experience a feeling of chilliness; then, however, a sensation of full comfort should occur, partly owing to the warming action of the bath on the skin, and partly from habituation. If, however, after a minute's quiescence this does not result, but rather the slight feeling of cold persists, then the bath must be slowly and carefully warmed to a temperature which is just sufficient for the purpose. In the majority of cases, as the cure advances, cooler and cooler temperatures are tolerated, and may be used with benefit.

"One should avoid, if possible, a second or recurring chill while in the bath. By this we understand that a patient who had become chilled on entering the bath, had later regained his warmth, and shortly thereafter had commenced to feel chilled again, after he had remained quiet for some time. Such a bath was too prolonged in relation to its tem-

perature. The temperature should either be rapidly raised or the patient should leave the bath at once. During the following days warmer baths should be given.

"If the baths are well tolerated, the stronger concentrations may gradually be employed. First, the concentration of the salts should be increased, especially that of the calcium chloride. At Nauheim we obtain this by the use of the mother-liquor derived from the spring, which contains 30 to 40 per cent of the calcium chloride. After these follow the baths containing carbonic acid, in a quiescent state, and later those rich in free carbonic gas; for these we employ at Nauheim, in rotation, the Thermal, Thermal effervescing, and Sprudel effervescing baths, as well as the effervescing flowing or Strom-Sprudel of the individual springs, with their different temperatures and their varying concentrations of salts and carbon dioxide.

"Patients with heart disease, without exception, require *days of rest,* on which the bath is suspended; in certain instances, especially with severe cases, a *pause day* is necessary, even after the first day; usually, however, after the second day. Later, three or four baths may be given on successive days. Simultaneously, an extension in the duration of the bath also takes place; it is, however, seldom advisable, particularly in severe cardiac lesions, to prolong them beyond 18 or 20 minutes. After each bath the patient should be wrapped in hot toweling and rubbed down vigorously, so that the skin becomes red and warm. He should then resume his clothing, and immediately seek his room where he should *rest in bed for at least one hour,* under a suitable covering, in order that the body may be rested and maintain an equable warmth. During this *rest-period* the mind should be kept quiet, and all reading avoided. In the further course we should endeavor to obtain a continuous, but, nevertheless, prudent stimulating action of the bath. The baths should be given always slightly cooler; always for longer periods, and at more frequent intervals. An exact supervision by the physician in regard to this should be constantly exercised. The result of today's bath is the criterion for tomorrow's orders."

The Schott exercises or resistance exercises used in conjunction with the baths are probably more important therapeutically than the baths themselves. There are 20 or more of them. They are very mild, and consist in the patient's making very simple movements against slight resistance on the part of the attendant. They are completely illustrated in a series of photographs published in the translation of Schott's "Balneo-gymnastic Treatment in Chronic Diseases of the Heart," (P. Blakiston & Co., Philadelphia).

TABLE XXI

SCHEME OF ADMINISTRATION OF ARTIFICIAL NAUHEIM BATH

| | Baths 1-3 | Baths 4-6 | Baths 7-9 | Baths 10-12 | Baths 13-15 | Baths 16-20 |
|---|---|---|---|---|---|---|
| Duration | 6 min. | 8 min. | 10-12 min. | 15 min. | 15 min. | 15 min. |
| Temp. | 94° F. | 93° F. | 91° F. | 89° F. | 88° F. | 87° F. |
| NaCl | 7 lbs. | 7 lbs. | 7 lbs. | 7 lbs. | 7 lbs. | 7 lbs. |
| CO mixt. | 0 | ⅓ package | ½ pkg. | all pgk. | all pkg. | all pkg. |
| CaCl | 1 lb. | 1 lb. | 1½ lb. | 2 lbs. | 2 lbs. | 2 lbs. |

## 2. The Douche

The douche consists of a stream of water or two streams of water being thrown on the patient with more or less force. During the douche the attendant does not touch the patient. Forms of douche are the *needle douche,* the *cold spinal douche,* the *spinal douche* or *Charcot douche,* the *Scotch douche* (consisting of two streams of water of different temperatures being directed on the trunk usually anteriorly).

All of these measures are used largely in some form of functional cardiac, hemic or nervous affections.

## 3. Mud Baths

For arthritis, synovitis, rheumatism of various kinds, mud baths applied in institutions in favored localities are unquestionably symptomatically beneficial. The Fango baths are given with Fango, which is an Italian volcanic mud about the consistency of butter, containing sulphur, iron, lime, potassium and sodium. It is said to be radioactive. Fango baths are given in the United States at Mudlavia, Attica, Indiana.

## References

Baruch: An Epitome of Hydrotherapy, W. B. Saunders Co. . A little book, full of enthusiasm by a master of the subject. A good book for students.

Brooks and Carroll: The Management of the Heart in Pneumonia, Am. Jour. Med. Sc., December, 1920, clx, No. 6.

Hinsdale: Hydrotherapy. A classic conservative volume.

Kellogg, J. H.: Rational Hydrotherapy, Battle Creek Modern Medical Publishing Co., 1918.

Mackenzie: Symptoms, Paul B. Hoeber, New York.

Macleod and Taylor: Penetration of the Tissues by Heat, Lancet, London, July 9, 1921, ii, 70.

# CHAPTER VII

## MEDICAL GYMNASTICS AND MASSAGE

By Carl O. Rickter, M.G.

*Graduate of the Kellberg Institute, Stockholm, Sweden.*

Medical gymnastics and massage have been in use among most people in some form or other as far back as we have any historical records. It is claimed that in Kong-Fu's Chinese "White Books," of unknown but very great age, certain forms of manipulations and movements are referred to.

From the time of the ancient Greeks we have certain information as to both massage and medical gymnastics. Hippocrates (460 to 377 B.C.) speaks of the use of friction in sprains and luxations and recommends abdominal massage for constipation. Among advantages that the Greeks gave to their conquerors, the Romans, many were medical and mechanotherapy was given great prominence mainly through Greek influence. Many physicians practicing in Rome were Greek, among them Asclepiades, who practiced shortly before the birth of Christ, and who has been considered the father of mechanotherapy in the Roman Empire. Galen took great interest in mechanical treatment and gymnastics and as his influence reached centuries after his death it did not entirely go out of use in the middle ages, though we hear very little about it up to the time of 1500, when the great Ambroise Pare strongly recommended mechanical treatment. Others of that time have written about it, as Leonard Fuchs in Germany; Timothy Bright in England; and the best known of this time Hieronymus Mercurialis of Italy, who, by many, has been looked upon as the inventor of massage. Even Lord Bacon took great interest in massage, and after his countryman Murrel, I cite Lord Bacons' opinion of massage: "Frictions make the parts more fleshy and full, as we see both in men and in the currying of horses. The cause is for that they draw a greater quantity of spirits and blood to the parts, and again because they draw the ailments more forcibly from within, and again because they relax the pores and so make better passage for the spirits, blood and ailment; lastly because they dissipate and digest any inutile and excrementitious moisture, which lieth in the flesh, all which helps assimilation." From this time on much has been written in Germany, England and France about gymnastics and massage, though it did not get a good foothold until the 19th Century. The most prominent man in the history of medical gymnastics and mas-

sage is probably the Swede, Per Henrik Ling, (1776-1839). He started his career as teacher of gymnastics and fencing and later on formed "The Gymnastic Central Institute" of Stockholm, where he remained a teacher until his death; and which school today is the foremost of its kind, where pupils gather from all over the world.

By massage we mean certain manipulations of the soft tissues with the hands; as kneading, pressing, stroking and hacking. Most authors agree to divide the handgrips into 4 classes:

Effleurage—Stroking.
Friction—Pressing.
Petrissage—Kneading.
Tapotement—Hacking, clapping, striking and vibrations.

Effleurage means centripetal stroking of varying strength, done with the palm of the hand, with the ulna or radial side of the hand, but often also done with the tips of the fingers. The most important part of effleurage is to speed up circulation in blood and lymphatic channels.

Frictions are made with the thumb or the three middle fingers, or sometimes with the fist; the motion is circular with more or less pressure. Frictions are used to break up infiltrations and exudates and press exudates into the lymphatic spaces. The direction in which this handgrip is done matters but little, but the pressure is rather important and has to be applied according to conditions of the part to be massaged.

Petrissage is done mostly by both hands at the same time, the thumbs on one side and the rest of the fingers on the other side. The part massaged is rolled between the fingers, pinched and sometimes lifted and kneaded. The result of petrissage is similar to that of frictions and tapotement.

Tapotement consists of manipulations that irritate muscles and nerves and is done with the ulnar side of the hand and the fist, as hacking, beating, pounding, slapping and vibrations. Vibrations are mostly done with instruments of different designs which work better than the hand.

The strength to be used in massage differs according to what is to be massaged. For example in a sprained ankle with intensive soreness, it is well to start effleurage; but in an old chronic joint disease with hard edema, strong frictions are required, and sometimes when no progress is made it may be necessary to use hard tapotement in order to make the disease acute. The condition of the patient naturally plays a large part as to what he can stand. The time for a local treatment varies from 10 to 20 minutes, and for a general treatment 30 to 35 minutes. The treatment should be given at least once a day, but in many acute diseases it is advisable to give two or three treatments a day.

The physiologic and therapeutic results of massage differ according to the handgrips employed. Effleurage hastens the circulation in the parts worked on both in blood and lymphatic veins; when the hand is stroking the skin with pressure it forces the blood and lymph towards the heart, emptying the veins and causing a suction in them which affects parts peripheral to the part massaged. The ability of effleurage to improve the circulation locally makes it valuable in the early stages of inflammations, as in an acute "Distorsio Pedis." An acute inflammation starts with a dilatation of the smaller arteries, capillaries and veins, a slowing of the blood, a gathering of the white cells around the walls and finally an emigration of the same into the surrounding tissues. In very acute processes they are followed by the red cells and blood plasma, making the muscles and tissues richer in serum and cells. The inflammation is Nature's way of doing the repair work of different kinds of injuries, but as it has its advantages, it also has its disadvantages. These can be corrected by science, especially by reducing the products of inflammation. Effleurage, through its influence on the circulation, works against the gathering of the cells and their migration and removes, through the lymphatic veins, the lymph and cells that already are in the muscles and tissues. In these cases the massage is given lightly and one starts the treatment by massaging centrally to the inflammation. After a few minutes' effleurage the redness becomes less, the swelling goes down, and the pain is reduced. Another advantage of effleurage is its ability to relieve fatigue; for example, let a boy chin himself as many times as he possibly can, then massage his arms for 10 minutes, then let him try it again; you will find that he can usually do it one-third times more than he could the first time.

By increasing circulation effleurage raises the perspiration of the skin and, under ordinary conditions, its temperature. Massage also reduces the skin's resistance to the electric current. Massage helps reabsorption as has been demonstrated experimentally. The joints of a rabbit are injected with a solution of tusche. Some of the joints are massaged for about 10 minutes, then all the joints are opened and it is found that the joints not massaged contain the tusche and are swollen, while in those massaged the swelling is practically gone and the tusche is in the lymphatic spaces centrally to the joint.

A great therapeutic advantage of massage is its ability, through the moving pressure, to heighten the regressive metamorphosis and reabsorption of products from inflammation. We refer here to infiltrations in skin and corium, in muscles, ligaments, tendons, fascias, capsules of the joints, nerves and their sheaths, perityphilitic, peri- and parametric exudates

and cellulitis of different kinds, in short the products of chronic and partly acute inflammation in different forms.

All forms of manipulations are valuable in these cases, but first of all are the frictions so, and are mostly given with great pressure, often very fast and sometimes only after long hard work are the more or less organized products brought to fat-degeneration and decay; and thereafter their small parts, through the same handgrip are forced into the lymphatic spaces. Furthermore, frictions hasten resorption of inflammation products by, after they are crushed, spreading them over a greater space, thus bringing them in connection with a greater amount of lymphatic veins.

Petrissage has, used on a group of muscles, the ability, through irritation on the muscle nerve, to create a feeling of strength and will invigorate the patient. It also causes local muscle contraction. Through its influence on muscles and nerves its result is sometimes like that of tapotement; but petrissage also has the same effect on resorption as the frictions have, though probably in a lesser degree.

All manipulations are mechanically irritating, but tapotement more so than the rest. All massage, and especially tapotement, works as a mechanical irritation to the skin and so improves its function as an excretory organ.

Tapotement on a muscle causes a local contraction which brings an added blood supply, added absorption, higher temperature and better nutrition; and this way to irritate a muscle is sometimes successful when electricity fails to cause a contraction. Tapotement is a rather important part of massage and helps to prevent muscle atrophy and restore thin and weak muscle groups to normal thickness and power of function.

The value of abdominal massage consists of the irritation of the smooth muscle fibers in the digestive tract, causing a contraction, and, as the treatment is repeated day after day, the muscles become strengthened and peristalsis improves. The general massage includes the abdominal treatment as well as the back, legs and arms, and the result is similar to that of gymnastics as to the chemical changes that take place in the muscles and throughout the system.

A general massage, and especially the abdominal treatment, raises the blood pressure and increases the amount of both red and white blood cells. The increase is mostly only a few per cent but sometimes will go as high as 20 to 25 per cent. The height of the increase will take place about ten minutes after the massage; last about twenty minutes, and then slowly retire. It also increases the urine, stimulates the whole body and improves sleep.

*Contraindications* for massage are: local skin troubles, unhealed fresh traumas, burns, erysipelas, syphilitic skin affections of different kinds, eczema, herpes, carbuncles, acne, lymphangitis, gangrene and all purulent and infectious processes. Some diseases of veins and arteries either forbid massage or furnish a caution to be very careful. An aneurysm can easily burst under vigorous massage. In phlebitis and bad varicose veins all hard massage is out of place, but sometimes a light effleurage may be of value. An acute phlebitis contraindicates massage absolutely. The same is true for a fresh or not fully organized thrombosis. It is best to wait two and a half to three months before touching a thrombosis, as by that time it is wall-fast and fully organized.

Tumors and all tuberculous infections, foreign bodies, osteomyelitis and all periosteal infections contraindicate massage. Severe general and local diseases where the patient needs ease and rest, do not invite massage. Of these we mean in the first place fevers. In certain cases of neurosis, psychosis and high grade neurasthenia, massage is of little value on account of the irritability and high sensitiveness of the patient. Abdominal massage is contraindicated in cases of pregnancy, ovarian cysts, acute inflammation: as peritonitis, appendicitis, salpingitis, liver abscess and certain conditions of the kidneys, ureters and bladder, gallstones, ulcers of the stomach and strangulated hernia.

As massage raises the blood pressure it is advisable to avoid it in cases where there is danger of hemorrhage into the brain. In well developed aneurysms abdominal massage is positively contraindicated.

Medical gymnastics are often given in connection with massage. Gymnastics are forms of systematic training of the organs belonging to the apparatus of movements, active movements and resistive movements. Passive movements are those that the patient makes through some other power than his own, as a masseur or a machine. Active movements are such as the patient makes unaided. Resistive movements are those which the patient makes with some power, offering resistance.

Passive movements lengthen and shorten the muscles and exercise the joints. Through them are stretched and broken up adhesions and other organized inflammatory products. Dried up capsules of the joints, ligaments and bands are stretched and in such a way help restore the power of function.

The best element in gymnastics consists of active movements during which the respective muscles produce active work. In the working muscles the veins are enlarged, the muscular respiration gets faster and metabolic changes are speeded up. The use of oxygen and the production of carbon dioxide are increased. The resting muscle's mildly alkaline reaction changes through work slowly to moderate acidity. The

production of heat is increased, the muscle's own temperature as well as the blood circulating therein is raised. The nutrition of the muscle is improved, and thus by steady training an atrophied muscle can be changed into an hypertrophied one.

Of great practical importance is the effect of gymnastics on the circulation. In the resting muscles of the body there is over one-third of all the blood. As the working muscle uses more blood than the resting one, and as the muscles represent a great part (45 per cent) of the body volume, it is easy to see the value of gymnastics in drawing the blood to the muscles from organs with an oversupply of blood. Gymnastics make the heart beats more frequent and stronger, and thus strengthen the heart muscle itself.

It also helps the respiration, increases the urine, and brings about a stronger intestinal peristalsis. It improves sleep, sharpens the appetite and does the whole system good.

I will now mention a few diseases in which massage and gymnastics are of value.

*Myositis* in its different forms probably is the most common disease that comes to the masseur for treatment and here massage gives excellent results. Its most common location is in the neck and shoulders. Massage is given lightly in the beginning and later increased, also movements such as head-twisting left and right, bending sideways, backward and forward. These movements are given slowly and steadily, not with quick jerks.

*Lumbago,* especially in the acute stage, is treated with effleurage. A good idea is to apply heat of some kind before massage. As the soreness disappears use frictions, petrissage and vibrations. The movements will be twisting and bending in the lumbar region.

Myositis in the abdominal muscles is not very common, but far from rare. To be able to massage the straight muscles let the patient inhale then, when he exhales, knead the muscles between the hands. Add active movements that will bring these muscles into play. All muscles of the body are apt to develop myositis.

*Subcutaneous infiltrations,* especially cellulitis of the fat tissues, respond quickly to massage. A subcutaneous cellulitis can be found on almost any part of the body, but the abdomen, the inside of the thigh, shoulders and arms are the common places. It is more frequent among women than men. A cellulitis does not ache, but the fat is highly sensitive. Very often we have a cellulitis in the fat and myositis directly under it. In well developed cases, the fat tissue is hardened and stiff. By lifting it up and rolling it between the fingers it gives a sensation of cracking. In all cases of neuritis of the neck and arm, that I have

treated, I have found it present, and in nearly all cases the removal of the cellulitis cures the neuritis. Cellulitis of the abdomen is sometimes mistaken for some internal trouble and it has happened, and might still happen, that women suffering from cellulitis and abdominal myositis have been subjected to operation. Rheumatic headaches are frequently caused by myositis and cellulitis of the neck and shoulders, and sometimes you can find both in the scalp.

The treatment of cellulitis is massage and the most effective handgrip is petrissage. Effleurage and some frictions may also be used.

Before leaving these two ailments I must mention the reflex pain that they sometimes cause. A myositis or cellulitis in or on the intercostal or pectoral muscles may make a patient believe he has heart trouble. If over the liver and stomach tract it may be diagnosed gall bladder trouble or ulcer of the stomach. As the cause of the reflex is removed, the other symptoms disappear and so another wonderful cure of gallstones or ulcers is accomplished by manipulations of some therapeutic name or other.

*Atrophy* caused by nonuse of the muscles, responds quickly to massage and gymnastics. Progressive muscle atrophy cannot be cured by massage, but the progress of the disease can greatly be delayed and sometimes a temporary improvement can be accomplished.

*Tendovaginitis crepitans* nowadays usually is treated with massage which brings quick results. If treatment other than massage is desired hot applications are next best.

*Chronic inflammation processes of the fascias,* especially of palmar fascias, often come to the masseur for treatment. In connection with orthopedic treatment, gymnastics and massage are of value, but results are only obtained after long and hard work.

In *bursitis* massage is of very little value. Some cases may respond to massage, but generally they do not.

In *traumatic joint diseases,* in distortion and luxations massage brings good results and should be used in acute as well as in chronic processes.

*Synovitis* of the knee is commonly treated with massage and good results are obtained. This disease requires hard frictions and sometimes it is necessary to acutize the ailment to get quicker results.

In the acute serous synovitis light effleurage is applied and, as the pain and inflammation diminish and especially if the disease shows signs of becoming chronic, frictions and hard manipulations are added.

The *chronic rheumatic joint inflammation* in its lighter forms and under good constitutional circumstances can be entirely cured by massage. In well-developed cases a cure cannot be promised, but some relief can be given and massage really gives better results than any other treat-

ment. In the worst cases, arthritis chronica rheumatica ankylopoetica, where not only the soft tissues but also the cartilage and even the bones are changed, massage is of no value.

*Arthritis Uratica* cannot be cured by massage, but if used in the early stages of the disease will give some relief and delay the progress of the gout.

*Contusion* and *distortion* are generally treated nowadays with massage, and effleurage is the handgrip to be used.

*Luxations* after reposition should be massaged. That means only traumatic luxations. Luxations caused by pathologic destructive processes and also habitual luxations do not gain by massage. The treatment will be effleurage, frictions and gymnastics to restore the movements of the joint.

*Fractures* usually indicate massage. After the cast or splint is removed there is mostly some edema present and the neighboring joints are more or less stiff. The treatment is to remove the swelling and work up the circulation and, by movement, restore the use of the joints. Old fractures that will not unite usually respond to massage. The handgrip to be used in these cases is effleurage, but sometimes it is a good idea to rub the ends of the bone together and so cause an irritation of the bone itself. Many surgeons nowadays will split the cast after a few days and apply massage and in this way keep the circulation good and so hasten the healing of the bone.

*Diseases of the heart* since the days of Ling have been treated with mechanotherapy in Sweden. The treatment consists of a general massage and light vibrations over the heart, passive movements in the joints of the toes, fingers, wrists, ankles, knees and elbows; chestlifting for the respiration and, as the patient improves, active movements.

*Pleurisy and Empyema* leave adhesions and stiffness in the intercostal muscles. Massage for the muscles and exercises to stretch and loosen the adhesions, are indicated.

*Pneumonia* used to be considered a contraindication, but in late years (even though it has been tried long ago) massage has been used and it seems very successfully. The treatment consists of massage of the abdomen, chest, neck and back.

*Constipation* offers a good field for massage. One starts in with frictions on the cecum and works the whole colon and small intestine thoroughly. The treatment should last about 15 minutes and is best given just before mealtime, never shortly after meals. Exercises are leg-rolling, leg-bending and stretching with resistance, trunk-twisting, bending and stretching give added help.

*Gynecologic massage* was introduced by Thure Brandt and gives good results in some diseases. This treatment is usually done in Europe by

a physician and the regular schools do not give instructions in this kind of massage.

The value of *prostatic massage* is recognized by everybody.

In *peripheral nervous diseases* massage is getting to be more and more used, but clear rules for its use are not yet established. Neuritis in the arms, shoulders and legs, when myositis or other infiltrations are present in the surrounding muscles, yields quickly to massage. When the cause is diabetes, gout or alcohol, the prognosis is not so good and improvement is slow and uncertain. Treatment consists of effleurage, frictions over and around the nerve.

*Neuralgias* of the facial or intercostal nerves often get relief or are cured by massage.

*Sciatic rheumatism* is in most cases myositis of the surrounding muscles. Massage of these muscles and especially hard frictions and tapotement give good results. Leg-rolling and stretching of the nerve are also of value.

*Tabes dorsalis* is in connection with medical treatment, treated with massage and gymnastics and often with fairly good results. The treatment would be a general massage and tapotement on the spine. Passive movements are of little value, but the active are the main part of the treatment. The Fränkel exercises alone sometimes bring a marked improvement.

*Poliomyelitis anterior acuta* should, as soon as the inflammation process is over, be treated with massage. The idea is to use massage so early as to prevent the afflicted muscles from becoming atrophied and help the nutrition in the same. The treatments consist of massage, mostly effleurage and petrissage, light vibrations and electricity. Movements are first passive and later active.

*Paralysis after acute infectious diseases* is treated in the same way as poliomyelitis.

In all cases of toxic paralysis massage should be used, but is largely overlooked in textbooks.

*Hysteria* has been treated with massage and gymnastics and the result has been in some cases good and in some not. The treatment should be given by an operator of the same sex and consists of a general massage and active movements, also vibrations on the head and spine.

*Neurasthenia* is treated with massage of the abdomen, back and base of the head; vibrations of the spine and the head; passive and active movements.

In this, my attempt to describe massage and gymnastics, I have only mentioned the most common diseases that are treated.

The list of diseases that, during some stage or other, are treated with mechanotherapy would be too long to cover in this chapter.

## CHAPTER VIII

## EXERCISE

Exercise may be ordered for the general effect, or to develop special muscle groups.

In general, exercise affects metabolism, muscle tone and the cardiovascular system. The general improvements in nerve reactions, mental viewpoint, gastrointestinal function, and renal function are secondary to the changes in these.

*The metabolic changes* affect the carbohydrate metabolism, fat metabolism and heat dissipation principally. The contraction of the muscles calls upon the glycogen reserve of the liver and burns it up steadily. If the exercise is sufficiently severe the glycogen reserve of the liver may be entirely exhausted. The glycogen reserve of the muscle is used but seldom exhausted, as the body attacks the fixed fatty tissues before using the last of the muscle glycogen. It is probable that fat is burned at the same time as the glycogen from the liver.

*The cardiovascular changes* during exercise are those affecting the heart muscle and the blood pressure. The effect of exercise on the heart is to increase its output per minute, either by a larger output of blood per beat, or by an increase in number of beats per minute, or (as is usual) by both. The splanchnic vessels are constricted and there is a rise in blood pressure. The rise in blood pressure may be used as a guide for the measurement of the heart's reaction during exercise. With a normal heart, the systolic pressure rapidly rises with exercise from a point of 120 mm. to 15 or 20 mm. higher. (Barringer says to 160 mm. or even 180 mm. but I have never seen such rises.) When the exercise is stopped, the rise continues for a few minutes and then a gradual but rapid fall to the previous point occurs. Mild loss of cardiac tone produces the same curve though it does not rise so high, but improves as exercise is continued; furthermore the exercise period can be sustained longer. Severe cardiac failure responds in the same way but exercise usually has to be stopped on account of dyspnea. In these patients the pressure remains up and the return to normal is delayed. Several mild forms of exercise are used by Barringer in his treatment of properly selected cardiac cases. The most convenient form is with dumb-bells, using those between 1 and 15 pounds in weight. They can be used by bedridden patients. Walking and playing croquet are types of milder, easily graded forms of exercise.

The tone of all the body muscles is improved by exercise, hence the posture is improved, the respiratory capacity is enlarged and oxygenation is more effective.

The effect of exercise upon the individual muscle is to cause hypertrophy. More important still is the increase in endurance. A certain muscular act, or a complicated exercise such as walking, running or swimming, if repeated day after day results in an enormous increase in the ability to continue it without fatigue. This is too well known to require analysis but must be pointed out to patients particularly when enjoining such exercises as those to increase abdominal tone for visceroptosis.

Special exercises are used extensively by the orthopedic surgeon for various atrophies and posture defects. The internist uses them largely

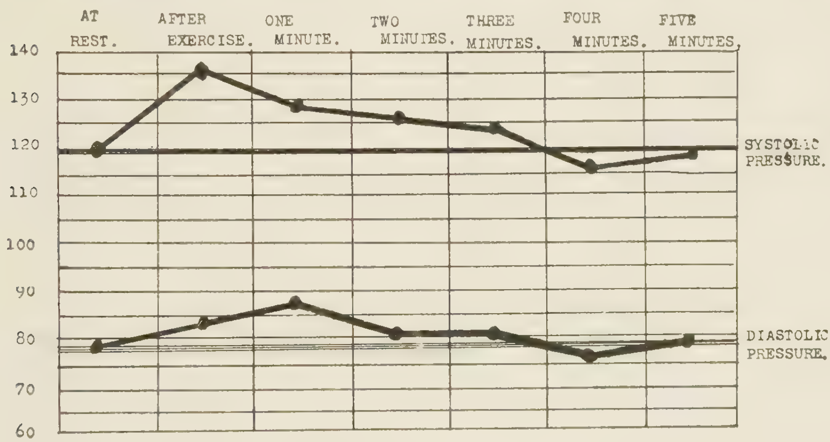



Fig. 33.—Effect of exercise on blood pressure. Record of actual observation. Exercise carried to point of breathlessness.

in the treatment of visceroptosis or gastroptosis to hypertrophy and improve the tone of the abdominal muscles. The exercises used for this purpose are of various sorts. Lying on the back and raising the legs with knees stiff as in Fig. 34-*B*, and then in the same position fixing the feet and raising the trunk to a sitting posture as in Fig. 34-*A*, are the ones most generally used. Perhaps the best is to lie on the back, flex the forelegs on the thighs and the thighs on the abdomen and then alternately try to touch the knees to the clavicles and relax (Fig. 34-*C*).

Exercises to increase the muscle control of the tabetic were originally introduced by Fränkel. In tabes great groups of deep sensibility sensations are gone. In time this leads to the loss of sensation for joint movement and muscle tension so that the coordination of muscle movements is lost. Fränkel believed that the tabetic could be re-educated

to walk just as the child is educated to walk by utilizing the eye and balancing (vestibular) senses. There are always some pathways and neuron groups in the cord and posterior ganglia in tabes which are not destroyed, and Fränkel proposed to attempt to develop these to the greatest extent.

In doing so he had the patient perform a series of definite movements, directing his legs or arms by the help of his eyes. If the patient is bedridden, a series of step-like grooves is set up at the foot of the bed against the baseboard and the patient instructed to place his heel regularly in these. Later setting-up exercises follow and finally walking is begun. When walking can be done at all, definite outlines of steps are placed upon the floor and the patient required to place his feet exactly

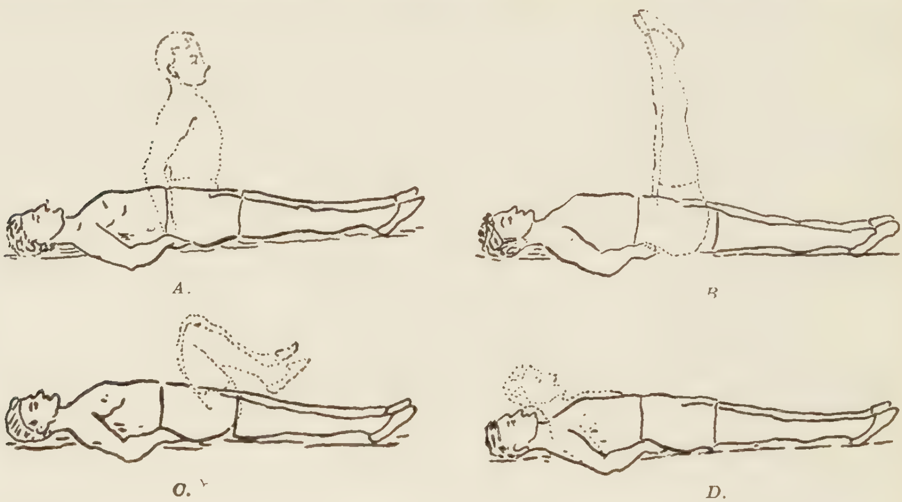


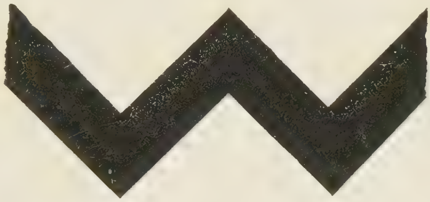
Fig. 34.—Exercises for strengthening tone of abdominal muscles.

on these outlines. This is done over and over again. If the upper extremity is most affected appropriate exercises are devised for the arms and fingers. No especial apparatus is required save what any physician can improvise himself.

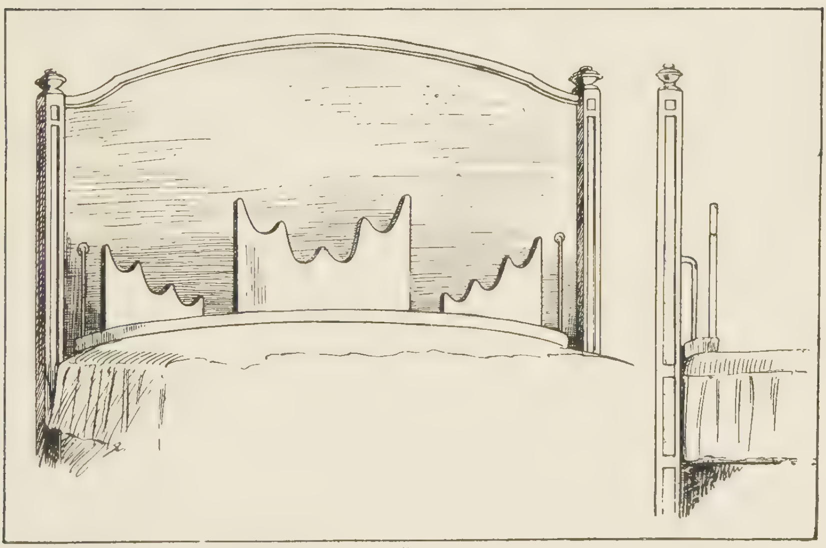
The improvement which occurs under such a regime may be almost magical. Bedridden patients get up and walk without the use of a cane. Much of the improvement depends upon the patient's character—grit and persistence win out here as in other things. The patient should be encouraged through the early stages with accounts of the success others have achieved, until his own improvement has encouraged him.

Maloney, while utilizing the general reeducational ideas of Fränkel, has worked out a plan of exercises which he believes superior to the earlier ones. The principal points of these are the cultivation of relax-

ation, and the blindfolding of the patient during exercises. The latter point is a direct deviation from Fränkel's idea of reeducating the tabetic through his ocular senses. It has its justification in the well-known fact that tabetics with optic nerve atrophy seldom develop ataxia. The remnant of the intact posterior root cells and fibers under Maloney's scheme are developed to their capacity. With the patient blindfolded Maloney will begin perhaps with the ankle joint and on moving it ask the patient if he feels any motion; if none is felt the motion is repeated



*A.*



*B.*

Fig. 35.—Exercises for locomotor ataxia. *A.* Figure to be drawn on the floor. The patient to place feet on each diagonal line alternately. *B.* Apparatus for foot of bed. Heels placed in each groove in succession.

until the patient begins to feel sensation. Then he is taught to associate properly, the physician saying, "This is an upward motion," "This is a downward motion," etc. In teaching the patient to balance he is placed with his back against the wall and then the eyes blindfolded. The feel of the wall gives him security: the swaying gradually diminishes. He is taught to stand on one foot; then the other. A step is taken and so on.

One final practical word about the use of exercise. Patients left to themselves will not keep on with exercises regularly. This is natural: everyone knows the monotony of such a routine. For those cases in which it is necessary that the exercises should be persisted in, the patients should be instructed to come to the physician's office and repeat the exercises there under supervision.

### Reference

Maloney: Locomotor Ataxia, New York, 1918, D. Appleton & Co.

## CHAPTER IX

## ELECTROTHERAPEUTICS

Electricity is commonly used for the treatment of disease in the form of static, galvanic, faradic, sinusoidal and high-frequency currents. No description of the technic of electrotherapy is permissible here, as each type of apparatus put on the market has a slightly different technic from the others. Inasmuch as there are always exact directions printed by the manufacturers and supplied with the machine this is not a serious omission.

**Static electrotherapy** consists in the application to the whole or part of the human body of discharges from a Leyden jar induced usually by friction machines transmitted through conductors or concentrators. The physiologic effects of its application to the body are muscular contraction, relaxation of muscle spasm, nerve stimulation or sedation and either stimulation or sedation upon the glands and circulatory systems. It has been used in insomnia, as a general stimulant in debility, in pruritus and eczema, in obesity, prostatic hypertrophy, herpes zoster, headaches, diabetes, rheumatoid arthritis and sciatica.

**Galvanic, faradic and sinusoidal currents** are used, according to Mochado, in curable central paralysis, and peripheral paralyses, such muscular troubles as myasthenia gravis, in membranous colitis, aneurysm, tuberculosis of a slow type and arthritis of various kinds.

Galvanism has been used in the treatment of paralysis for many years and is probably the most helpful form of electricity.

**High-frequency currents** have been used by the medium of vacuum electrodes in various skin diseases and in myalgia, neuralgias, etc. **Fulguration** is the application of long and powerful sparks for the destruction of morbid tissue, such as skin tumors, bladder tumors through the cystoscope, etc.

Autocondensation with the D'Arsonval apparatus has been used in many diseases especially in hypertension or high blood pressure. In this I can record some personal experience. There was a great deal in the literature on the subject which induced me to experiment with it, particularly a favorable opinion of Clifford Allbutt's. There is no doubt that autocondensation will reduce the blood pressure from 20 to 40 millimeters of mercury at a sitting. But the reduction is only temporary and after an extended trial I can say that I have seen no permanent

beneficial effects from it whatsoever. The accounts of its use in diabetes appear to be written entirely by persons who, whatever they know about electricity, know nothing at all about diabetes.

**Diathermy** "is the name applied to the application of high-frequency currents of many hundred milliamperes or even over an ampere generating a great deal of heat in their passage through the tissues" (Tousey). Heat is driven deep into the tissues.

It has been used in a wide variety of conditions. In pelvic infections in women its action is very rapidly beneficial. Competent gynecologists, such as Gellhorn, consider it more effective than surgery under certain conditions. An outer ribbon electrode encircling the waist and an electrode in the vagina will concentrate the heat at the proper point. Temperature of 115° F. in the vaginal electrode is the standard amount. Treatments last from twenty to thirty minutes and are given every three days. In all gonococcic infections its action is beneficial.

In pneumonia diathermy has been extensively used and enthusiastic reports are recorded. It is difficult to evaluate these, as therapeutic results in pneumonia are very fluctuating. Bruger and Christie report that on account of the character of the pulmonary circulation, diathermy does not raise the temperature of the lung to any extent.

## References

Bruger and Christie: Diathermy in Pneumonia, Jour. Am. Med. Assn., Aug. 11, 1928, xci, No. 6.

Corbus and O'Conor: Diathermy in the Treatment of Genitourinary Diseases. St. Paul, 1925, Bruce Publishing Co.

Gellhorn: Diathermy in Gynecology, Jour. Am. Med. Assn., March 31, 1928, xc, 1005.

Tousey: Medical Electricity, Roentgen Rays and Radium. Philadelphia, 1921, W. B. Saunders Co., ed. 3.

# CHAPTER X

# RADIOTHERAPY

BY E. H. SKINNER, M.D., AND E. R. DEWEESE, M.D.

## I. DEFINITION AND TECHNIC

Radiotherapy is the application of radium or x-ray in the treatment of disease.

**Radium therapy** requires the element radium which is obtained in the reduction of the minerals known as carnotite and pitch-blende. It is quite expensive but it loses only half its value by emanation in 1700 years and barring accident may be continuously useful.

**X-ray or Roentgen Therapy** requires apparatus, now quite generally and uniformly manufactured, which produces a high voltage current by means of a step-up transformer, which is in turn conducted to a glass tube of high vacuum from which x-rays are given off. Neither the apparatus nor the tubes last long, their life being from 0 to 10 years. Constant improvements force an early uselessness of tubes and parts. Much attention is demanded to proper installation, care and preservation of apparatus. A knowledge of practical electricity, roentgen physics, dosage, filtration and application are preliminary requisites. Apprenticeship and experience are as essential to successful roentgen therapy as in surgery or medicine.

### Radium Therapy

In the treatment of disease radium is used in four ways—radium plaques, radium capsules, radium needles and emanation points. The value of radioactive waters and injections of radioactive substances is quite experimental, not sufficiently proved to warrent discussion here.

**Radium Plaques** are used for the treatment of skin lesions or ulcers at the mucocutaneous junctions. They are not of sufficient strength for any deep condition or glandular swelling. Plaques are made up of five, ten and twenty milligrams of radium element and are designated as double-strength, full-strength or half-strength, according to the surface area of the plaque. The dosage for surface application is based upon the amount of radium and the surface area of the plaque.

**Radium Capsules or Tubular Applications** are made to contain 25, 50, or 100 milligrams of radium element. The radium element is sealed in a small glass tube and this is placed in a silver, gold or brass capsule

with a screw cap. The glass tube of radium should never be removed from the metal container. This metal capsule may be placed in larger brass, lead or rubber capsules to obtain additional filtration and distance. These radium capsules are useful in many conditions. They can do the same work as a plaque with proper attention to filtration and distance. They are useful in cavity work and for block application to tumors. Capsules can never be boiled or submitted to excessive heat.

**Radium Needles** contain from 3 to 12.5 milligrams of radium element, which is sealed in a small hollow metal needle, constructed with a point and an eyelet. They can be boiled. Needles are useful for more purposes than any other form of radium applicator; because they can be loaded into capsules and spread out with proper filtration for surface applications, and, principally, they can be inserted in tumor masses to obtain a more uniform distribution of radiation. They can, therefore, do the work of plaques or capsules and they may be inserted into tissues.

**Radium Emanation Points** are small capillary glass points containing from 1 to 2 millicuries of emanation from a large supply of radium element. At least 500 to 1000 milligrams of radium element is necessary for an emanation plant. The apparatus for capturing the emanation consists of an elaborate rigging of glass tubes and bulbs and requires an intelligent physicist to supervise its daily operation. One millicurie is the amount of emanation given off by one milligram of radium in one hour. It is possible to capture about 150 millicuries from 1000 milligrams of radium element in 24 hours. But practically this amount is not achieved. These emanation points lose half their value in 3.85 days. They are useful for insertion directly in diseased tissues where they remain and continue to radiate the tissue until their value is nil. They lose 15 per cent of their value daily. Besides their value by direct insertion they may be placed in capsules or made up into surface applicators. Emanation points would be the most useful means of applying radium, except that it requires such a large amount of radium element, such costly apparatus and supervision. It is available only at three or four sources in America. It is practical only in endowed clinics. The general radiotherapist may as well forget it and attempt to duplicate or parallel emanation therapy methods by radium needles.

**General Considerations upon Radium Dosage.**—The application of radium to superficial lesions demands rather uniform surface coverage. This is easily accomplished with plaques. It is more easily secured by needles than capsules.

Needles of 10 to 12.5 mg. may be arranged upon appropriate thicknesses of dental compound (Kerr), thin felt or tire repair stock (Fisk

No. 220 or No. 224) to secure even distribution over a given lesion. Some radium dealers turn out brass needle racks with one side partially cut away for surface work but these cover a small area only and provide too much concentration of dosage for large areas.

Capsules of 25 mg. must be raised from a lesion to cover areas of any size. It must be remembered that the law of light losing its intensity with the square of the distance holds for radium. The increase in distance of capsules with the added filtration of the material used to secure distance must be taken into account.

Emanation points are rarely used for surface applications. They may, however, be used like needles as described in the above paragraph.

There are two methods of application for surface work with radium.

1. By divided or fractional dosage at repeated intervals.
2. By a single and complete dose to the lesion.

Results are obtainable by both methods and there are no hard and fast rules as to choice of method. The choice is usually determined by practical philosophy and the mental attitude of the physician toward patients. The financial attitude also seems to be a matter of no mean moment.

By the divided dose the reaction is gradually achieved and can be watched from day to day. It does not require as much experience or exactness as the single dose. With the single dose there is usually a decided reaction in 10 to 14 days which persists for two weeks or more and then gradually subsides. There is a demand for calculation in the single dose, taking into consideration the depth of the lesion, the distance of the applicator, the amount of crusts, scales, margins and the filtration.

**Depth Dosage** to tumor masses demands the attempt to secure as much radiation to the deep parts of the tumor as to the surface. The deeper the lesion, the further away must the applicator be placed. This further demands increased filtration and increased time and cross-fire.

A simple calculation upon a supposed tumor of 3 cm. diameter with the circumference touching the skin may be useful. If the radium was placed directly upon the skin, the area 3 cm. deep would receive only 1-9 of the skin dosage. If the radium was raised 3 cm. above the skin thus making the distance 6 cm. or twice the skin distance to the deep circumference of the tumor, the deeper cells would only receive the square of 2 or 1-4 the skin dosage. It would thus require four areas of cross-fire to achieve uniform dosage throughout the tumor. It is not usually practical to raise any radium surface applicator more than 3 cm. above the skin.

## II. APPLICATIONS OF RADIOTHERAPY

The diseases in which radiotherapy is used may be classified as follows:

I. Tumors.
  a. Carcinoma.
    1. Of the skin—epithelioma, rodent ulcer, keratoses.
    2. Of the tongue and buccal cavity (including leucoplakia).
    3. Of the esophagus.
    4. Of the vagina and cervix.
    5. Of the prostate.
    6. Of the rectum.
  b. Sarcoma.
    Lymphosarcoma; glandular sarcomata. Any primary sarcoma of bone is rarely influenced.
  c. Benign tumors.
    1. Fibroid of the uterus.
    2. Keloids.
    3. Verruca.
    4. Angioma.
II. Diseases of the skin.
    Tinea sycosis, tinea favus carbuncles, hair follicle infection, acne, psoriasis, and tumors as above.
III. Diseases of the Lymphatics.
    1. Hodgkin's disease.
    2. Lymphosarcoma.
    3. Tubercular adenitis.
    4. Metastatic carcinoma.
    5. Enlarged thymus.
IV. Diseases of the thyroid gland—principally the toxic symptoms.
V. Diseases of the blood.
    1. Splenomedullary leukemia.
    2. Lymphatic leukemia.
    3. Polythemia vera.
VI. Diseases of the alimentary system—as above under tumors.
VII. Gynecologic conditions.
    1. Menorrhagia and metrorrhagia.
    2. Tumors as above.

Radiation therapy may not always be the treatment of choice in the pathologic conditions found listed under the above headings, but it must

be given due consideration as available and effective if symptomatically administered.

Neither will it be argued that when radiation therapy is applied that it results in cure of the condition. But it is maintained that the span of comfortable existence may be increased.

## The Action of X-Ray and Radium on Cancer

The variability of tissues to radiation is a well established fact. Not only do the normal body tissues vary in their reaction, but various tumor tissues have differences of susceptibility, almost specific in some cases or so resistant as to be almost totally unaffected. Other factors which must always be considered in predicting the results of radiotherapy on tumors are the pathologic complications and the age and nutrition of the patient. It has often been observed that the plethoric types of patients do not respond nearly so readily as those of the asthenic habitus.

The first principle of radiotherapy is the variability of different tumor tissues to radiation. It would appear that the greater the degree of differentiation from the embryonic type and the more highly specialized the tissue cells, the less resistant to radiotherapy. The cellular, anaplastic, clinically highly malignant, rapidly growing and disseminating tumors, derived from previously adult cells, are generally very susceptible to all forms of radiation, although on account of their rapid dissemination the prognosis is always unfavorable.

Certain general factors enter into the question of tumor tissue resistance. It is believed that the dividing nucleus is more susceptible than the resting nucleus. Richly and delicately vascularized tissues are invariably susceptible to radiation and the marked decline in bulk often exaggerates the real effect of the radiation dose. On the other hand the presence of much intercellular substance, especially if mucinous, fibrous or hyaline, effectually prevents decrease in the bulk of radiated tumors. Consequently the decline in bulk is not a safe criterion of tumor destruction for it may be only absorption of fluids, slowing of secretions, draining of cysts, or closure of vessels with central necrosis, while peripheral cells remain intact and active.

The impression has long prevailed in the minds of many that x-ray and radium cure cancer by killing the cancer cells. This idea is an inheritance of the old surgical point of view, that the cancer must be exterminated root and branch.

Ewing describes the actual changes which have been observed following x-ray and radium applications as follows:

"When a practitioner possessing a small amount of radium applies it to a rodent ulcer in repeated small doses over a period of weeks he

usually observes the disappearance of the tumor and very often it never recurs. Meantime, the skin shows a little reaction and the scar is small or absent. Exactly what he has done no one knows, but he has not killed any cancer cells. Sections taken at intervals throughout the tissue so treated, show hyperchromation of nuclei and hydropic swelling of tumor cell bodies followed by gradual atrophy of the cells. At the same time the surrounding tissue becomes active, leucocytes emigrate, lymphocytes and plasma cells appear, capillaries proliferate and all these invade and replace the tumor mass. A slow regressive process with degeneration of tumor cells, and a progressive process with exudation and proliferation of normal tissues are set going and as a result of these processes the tumor is cured."

The same changes have been observed following x-ray and radium applications to tumors of the deeper structures; that is, a wide tissue reaction about the tumor mass with all stages of atrophy in degenerating tumor cells. It appears probable that the reaction of the tissues is an essential curative process. In cases where this reaction fails, no amount of radiation succeeds in eliminating the cancer cells.

In view of the above reservations it would seem that a too vigorous attack upon the malignant tissue and adjacent structure could easily defeat its own purpose by devitalization of the reacting proliferating tissues. *On the other hand, Ewing has never observed anything that could be clearly interpreted as stimulation of tumor growth by radium or roentgen ray.* Neither has he found any properly attested record of such an event.

It is an important law of pathology that necrosis of tissue cells usually results from failure of circulation. This law has few exceptions in radiotherapy for it is usually found that when large masses of deep tumor tissue have been destroyed by radiation, the necrosis is due to the occlusion of the delicate blood vessels resulting in anemic infarction and secondarily to death of tumor tissue.

To summarize: The curative action of radiotherapy in cancer is not the result of a direct effect exclusively upon the tumor cells, but involves especially a peculiar reaction of the normal or invaded tissues. In this reaction are doubtless included many fundamental physiologic properties of the tissue which under the term inflammation have deeply engaged and invariably baffled the master minds of medicine. Moreover, this simple morphologic interpretation reveals the highly important fact that by treating cancer by physical agents we are not merely destroying cancer cells in the sense of the physicist, nor extirpating entirely according to the surgeon's plan but calling upon Nature's forces to accomplish the cure.

### The Tegumentary System

a. Cancerous and precancerous lesions. Epitheliomata, Rodent Ulcer, Sarcomata and Keratoses.

b. Parasitic and infectious diseases: Tinea Sycosis, Tinea Favus, Carbuncles, Furuncles, Hair Follicle infections.

c. Benign growths: Keloids and Warts.

d. Metabolic Diseases: Acne Vulgaris, Eczema, and Psoriasis.

There is practically no argument as to radiation therapy being a treatment of choice in the cancerous and precancerous lesions, the benign growths (Keloids and warts) and in the tineas. The value of radiation in the hair follicle infections, furuncles and carbuncles has not enjoyed the favorable attitude it really deserves. They are quite common and their treatment by the usual antiseptic measures and incision does ultimately result in relief. They can be afforded a briefer course if treated kindly by radiation.

Epilation by radiation is possible but difficult. It is doubtful whether this treatment will ever be very popular.

In the metabolic diseases radiation is only one of several measures available and must be considered only as an adjuvant in the complete therapeutic attack.

### Diseases of the Lymphatics

Anyone who has seen large lymphosarcomata of the neck melt away under radiation will hardly care to again submit any such case to excision. The maintenance of the recession over an indefinite period is open to argument, but it certainly provides a more satisfactory outlook than surgery.

Tuberculous and chronic adenitis are debatable for surgery or radiation. The experienced radiotherapist attacks them with confidence as does also the capable surgeon. An indifferent radiotherapist may be better than an inexperienced surgeon. It is regrettable that the patient is rarely in a position to make the proper choice.

There is much to be said for radiation in any lymphatic disease. Lymph tissues and organs are more easily influenced than any other tissue in the body. The variation of effective dosage is one proof and the symptomatic recession of any glandular growth under radiotherapy is an empirical proof. Histologists record the most profound changes.

Pathologic imagination has barely invaded the field of radiotherapy. The proved points to date are merely indications of the future possibilities. The effect of penetrating radiation upon tissues and the possibility of influencing growth and repair is about in the position of wireless telegraphy years ago.

## Technic of the Treatment of Hodgkin's Disease or Lymphosarcoma with Radium and the X-ray

**Dosage X-ray.**—Mark off the surface of the tumor with an indelible pencil into square areas 5 x 5 inches or 12 x 12 cm. To each area deliver 300 milliampere minutes at 16 inch distance from tube anode to skin at 140 kilovolts with .5 mm. copper and 1 mm. aluminum filtration.

If only 5 mm. of aluminum is available for filtration, reduce the dosage to 100 milliampere-minutes.

One hundred forty k.v. equals a full 10 inch spark gap capacity.

Repeat dose at 4 to 6 week intervals.

**Dosage of Radium.**—Mark off the surface of the tumor mass into skin areas 6 cm. square. To each area give 1000 milligram hours of radium with 1 mm. brass and 2 mm. lead filtration at full 3 cm. distance. Repeat dosage in six weeks. Use hard felt, wood or dental compound to obtain distance. Thusly, it will require 100 milligrams of radium for 10 hours to obtain the dosage for each area. Fifty milligrams would demand 20 hours to each area. Do not neglect the distance and filtration factors.

**Results.**—No case of Hodgkin's disease is on record as being permanently cured with radiotherapy (or any other means) but it offers prolonged relief and comfort to the patient.

## X-ray in Thymic Hyperplasia

**Indications for Treatment.**—Thymic hyperplasia is usually a disease of childhood and manifests symptoms during the first few years of life. The mother presents the child for medical examination most frequently because of some difficulty of respiration or "choking," the story often being "after a vigorous crying spell the child becomes 'blue' and is unable to get his breath." This should suggest to the examining physician the question of thymic hyperplasia. If properly made and interpreted x-ray negatives along with fluoroscopic study are valuable in the diagnosis.

There usually is a history of continuous or intermittent dyspnea; (1) suffocating attacks; (2) cyanosis and stridor; (3) thymic dullness over the sternum. The x-ray negative reveals a broad upper mediastinum with borders which are not continuous with the heart shadows but contiguous thereto. An overlapping shadow to the left of the sternum and an elephant ear shadow over the right aorta, increased upon expiration usually means definite thymic enlargement. Given the above findings the patient is entitled to a therapeutic test by x-ray as it has been proved harmless whether in normal or abnormal individuals.

**Technic and Dosage.**—The average dosage consists of an 8 to 9 inch spark gap, 9 to 10 inch distance, 4 mm. of aluminum filter, 25 ma. minutes (5 mm. for 5 minutes). Mild cases receive one dose anteriorly. Severe cases may receive the above dose anteriorly and posteriorly. Treat at intervals of one week unless more relief is urgently demanded. The second dose may be given on the third day. If treatments are continued or repeated frequently, the dosage factors must be reduced. Recurrences due to reactivation of the gland are to be watched and controlled by further treatment.

**Results.**—Results are uniformly good; the patient may show improvement within 24 to 48 hours. No x-ray deaths have been reported. The roentgen irradiation of a thymus produces artificial involution of the gland. The symptoms rapidly disappear and subsequent negatives and fluoroscopic study show definite recession of the thymic shadow.

## X-ray in Goiter

**Indications.**—To the average radiologist there are two types of goiter. The one he can treat with some measure of success, but the other he cannot influence in the least. This is not a scientific classification but it is practical.

Radiotherapy is a method of choice in toxic hyperplastic goiters with no pressure symptoms. Upon the contrary, radiotherapy is never a method for consideration in a nontoxic tumor of the thyroid which produces pressure symptoms: these demand surgery.

Two other types may require radiotherapy, i.e., the nonhypertrophic, toxic goiter with a high basal metabolism rate and the poor surgical risk. It is beyond dispute that the radiologist is a good surgical assistant in preparing many toxic cases for surgery.

Radiotherapy then is a symptomatic treatment for hyperactivity of the thyroid and the mere presence of an enlarged thyroid is not sufficient basis for a radiotherapeutic attack.

**Technic.**—The dosage of radiotherapy is inversely proportional to the severity of the symptoms. The more toxic the patient the smaller and more frequent the x-ray dose. The less toxic, the more massive the dose and at less frequent intervals. The extremely toxic patient, who is also most likely to be extremely nervous, should have the x-ray brought to him (a silent portable apparatus) or should have radium. In the less toxic cases they may come to the office or laboratory, at intervals of one, two or three weeks or as the experience of the radiologist demands. There is much latitude in x-ray dosage of goiters; a safe average would be 8 inch gap, 4 mm. aluminum, 9 inch distance, 5 ma. for 4-5 minutes over each lobe of the gland. Somewhat heavier dosage may be applied

to the gland posteriorly, through the neck in cases where more radiation is demanded at shorter intervals. It may be necessary to continue the treatment over a period of weeks, even months.

The use of radiotherapy does not relieve the physician from demanding physiological rest or other adjutant measures which have proved values.

## Diseases of the Blood

### X-ray and Radium in Leucemias

When the diagnosis is established by the blood count and clinical findings, radiotherapy is at once indicated. This may be pursued by x-ray or radium.

**Technic.**—It is the concensus of opinion among men of experience in the treatment of leucemias that successful results require much care in the initial radiation. Small doses should be given at first to establish tolerance to radiation. Persistence in treatment is demanded until all manifestations of the disease have disappeared and resumption of radiation is called for upon the first evidence of relapse.

The usual plan of procedure in cases of leucemia is x-ray exposure on alternate days over the spleen, anteriorly and posteriorly, and over the long bones with 8 inch spark gap, 5 ma., 5 minutes, 4 mm. aluminum, 10 inch distance.

Radium in areas 6 cm. square over the spleen, at 3 cm. distance from skin, 100 mg. radium, 1 mm. brass and 2 mm. lead filtration for six hours.

As soon as the blood picture is sufficiently improved, which usually takes place in about six weeks, the treatments are interrupted and close observation for any evidence of relapse is maintained.

**Results.**—The institution of modern methods of deep therapy in leucemia, modified to suit the peculiar condition, has seemed to induce a primary symptomatic cure, with an increase in the length of life. However, the ultimate results are still unimproved. Radiotherapy of the lymphatic and myelogenous types of leucemia has been demonstrated to be of value in approximately 80 per cent of cases. These patients remain well over a period which may vary from a few months to a few years depending usually upon the duration of the disease prior to institution of treatment.

### Polycythemia Vera

Pendergrass has advocated the use of the x-ray over the bones of the entire skeleton and then over the spleen in this rare disease. The bone marrow receives an inhibitory dose, the spleen a stimulating dose.

This would seem to be the most rational method of treatment, as the disease consists in an increase in the number of red blood cells of unknown cause.

### The Alimentary System: Leucoplakia; Labial Cancer; Cancer of the Mouth; Esophageal Cancer; Rectal Cancer

Years ago Abbe maintained that radiotherapy was the treatment of choice in leucoplakia. Probably no mucous membrane menace melts more miraculously.

Labial cancer and cancer of the mouth will probably always be a battle ground for argument between radiotherapist and surgeon. If the patient would submit to the extreme demands of the capable surgeon at the early period when his lesion appears innocent then would surgery be a treatment of choice. How many patients even listen to such experienced advice? Really, the effective surgery must be completed when the lesion is in the precancerous stage. Too many surgeons are still willing to excise the original lesion and let the glands alone.

**Technic of the Application of Radium in Cancer of Esophagus.**—The area and extent of the esophageal lesion must be determined by the fluoroscopic use of the x-ray with an opaque mucilage (equal parts of barium and Horlick's Malted Milk mixed with a few drops of water).

The amount of radium necessary is 25 to 100 milligrams in capsules which are placed in an appropriate applicator and inserted into the esophagus to the area of the lesion under fluoroscopic control. The dosage of each 3 cm. length of the lesion should be at least 300 mgh. (milligram hours). Thus, 50 mg. of radium in 1 mm. brass filter, or equivalent, should remain at each 3 cm. portion of the lesion for 6 hours; or 25 mg. for 12 hours or 100 mg. for 3 hours.

Esophageal bougies are manufactured with a hollow tip for the radium capsules or needles. The treatments may be continuous under twilight sleep or at intervals of two days until the full dosage is obtained. If the treatment is given in broken doses the dosage may be increased 20 per cent each séance.

The esophageal applicator must be anchored at the mouth by adhesive or suitable harness. It may be moved up or down to include the whole extent of lesion in the treatment.

The entire treatment scheme may be repeated in one month to six weeks if required, but the ambition should be to give sufficient dosage the first treatment to control the situation.

The reaction at the lesion from the radiation treatment may be considerable. Edema and temporary stenosis may occur which will not persist more than three to four days, however.

It is difficult to accomplish anything in cases which refuse bougies less than 26 caliber.

## References

### *Thymus*

Cook: Roentgen Therapy in Hypertrophy of the Thymus Gland, Boston Med. and Surg. Jour., 1916, clxxv, No. 14.
Friedlander: Am. Jour. Dis. Chil., July, 1917, xv, No. 1, p. 40.
Grulee: Int. Clinics Series 29, 1919, No. iii, p. 42.

### *General*

Holding: Hodgkin's Disease, Ann. Surg., 1917, lxv, 686.
Knox: Radiotherapy and Radiotherapeutics, New York, Macmillan & Co., 1915.
McAlpin and von Glahn: Arch. Int. Med., November, 1922.
Pendergrass: Polycythemia Vera. Treatment by Roentgen Ray. Am. Jour. Sc., May, 1921, clxi, No. 5.
Pfeiffer: Beitr. z. klin. Chir., 1906, l, 262.

## CHAPTER XI

## CLIMATE, ÆROTHERAPY, HELIOTHERAPY, MINERAL SPRINGS, HEALTH RESORTS

The medical use of climate is a subject which has a great deal of reputation with the laity, but for which there is not much scientific justification. Patients are often benefited by change to a different climate, but it is quite difficult to say whether the climate itself or the accompaniments of it—rest, change of scene, the passage of time, careful diet, etc.—accomplish the result. Nor have those practitioners who live in some particular climate been able satisfactorily to establish an acceptable scientific reason why climate is of value. In discussing the matter here we will simply indicate very briefly what has come to be believed about the value of various climates and the diseases in which they act, avoiding critical comment.

Climates vary in respect to seven conditions: altitude, temperature, moisture or humidity, variability, winds, electrical disturbances, and amount of rainfall. Ellsworth Huntington believes that the most progressive people have always lived in the most variable climates—those in which there was a maximum of meteorologic change from day to day. He studied the effects of weather upon groups of factory employees, and states that barometer changes had little effect, humidity possessed considerable importance, but that the most striking changes were brought about by temperature. The workers were most active when the outside temperature was 60° to 65° F., but mental work was best done when the outside temperature was 38° F. and the inside about 70° F. People do not work well when the temperature is constant, but great changes are also unfavorable to steady work.

**High Altitudes.**—From time immemorial high altitudes have been considered good for respiratory disease, particuarly tuberculosis. The highest elevations in the United States where patients with tuberculosis go in large numbers are in Colorado. Colorado Springs is 6000 feet above sea level. Most points in New Mexico and Arizona are the same. Saranac is about 1750 feet above sea level. The Swiss resorts are about the same as Colorado. Davos is 5120 feet, and St. Moritz 6100 feet above sea level. These resorts at high altitudes are helped by the character of the sunlight which is discussed below in the section on heliotherapy.

The changes which occur in the body at high altitudes have been studied

by various observers. The most striking changes are in the blood. There is a constant increase in the red blood corpuscles and the hemolgobin. This results in better general oxygenation. Webb and Williams studying tuberculosis patients found an increase in the lymphocytes both relatively and absolutely, and they argue that since the lymphocytes are the cells of defence in tuberculosis this indicates a better prognosis.

The influence of high altitudes upon organic heart disease has long been supposed to be bad. Sewall states that the high altitude exerts its principal influence upon the right heart. With less oxygen per cubic centimeter in the air it is necessary for the blood to visit the lungs in greater amount (another theoretically helpful thing for tuberculosis) and therefore puts an extra burden on the right heart tending to overfilling. Organic heart disease seems to suffer no damage, however, in high altitudes provided compensation is effective. But it is certainly true that with the earliest signs of broken compensation these patients should be sent to lower altitudes.

There seems to be no doubt that high altitudes cause nervousness (i.e., restlessness and insomnia) if residence is maintained for a continuous period and it is the custom for citizens of Denver, for instance, to go once or twice a year, circumstances permitting, to a lower level.

Dr. Sewall warns that patients going to Colorado should be cautioned that it requires a rest period of two weeks for an individual to become acclimatized at the elevation of Denver. Many cases of tuberculosis die within two weeks after reaching Denver or Colorado Springs apparently from edema of the lungs because they have not taken time to acclimatize themselves by a preliminary rest. Such occurrences never happen after the individual has been in Colorado over several weeks.

## THE FRESH AIR AND ALTITUDE TREATMENT OF TUBERCULOSIS

The use of certain climates—of high altitude, coolness and much annual sunshine for tuberculosis—is a gradual development of the idea of the use of fresh air for tuberculosis. This began in the mind of a fine old English practitioner, George Bodington, whose essay "On the Treatment and Cure of Pulmonary Consumption" was published in 1840. Let us go back and quote a few paragraphs from this production, the ideas in which were considered so fantastic then.

"A uniform and complete success having resulted in the treatment of several cases of tuberculous Consumption upon the principles and plan explained in the following pages, the author deems it his duty to publish them, with his opinions and principles of treatment.

"It would not accord with the brevity and conciseness of the plan of this treatise to enter at length into the nature and causes of Consumption, the diagnostic symptoms, physical signs, morbid anatomy, etc.; these are subjects which have been elaborately handled by several eminent authors, whilst little has yet been done by way of improvement in the treatment of the disease. Consumptive patients are still lost as heretofore; they are considered hopeless and desperate cases by most practitioners, and the treatment commonly is conducted upon such an inefficient plan as scarcely to retard the fatal catastrophe. One mode of treatment prevailing consists in shutting the patients up in a close room, to exclude as far as possible the access of the atmospheric air, and then forcing them to breathe over and over again the same foul air contaminated with the diseased effluvia of their own persons. But what could rationally be expected to be the result from such practice than that of the conversion of a slow or moderate consumption into an intense or galloping one? This is, indeed, a treatment founded on the most erroneous principles, and is much more deserving of reprobation than is even the apathetic indifference and desperate hopelessness generally entertained with regard to this disease.

"The only gas fit for the lungs is the pure atmosphere freely administered, without fear; its privation is the most constant and frequent cause of the progress of the disease. To live in and breathe freely the open air, without being deterred by the wind or weather, is one important and essential remedy in arresting its progress—one about which there appears to have generally prevailed a groundless alarm lest the consumptive patient should take cold. Thus one of the essential measures necessary for the cure of this fatal disease is neglected, from the fear of suffering or incurring another disease of trifling import.

"Farmers, shepherds, ploughmen, etc., are rarely liable to consumption, living constantly in the open air; whilst the inhabitants of the towns, and persons living much in close rooms, or whose occupations confine them many hours within doors, are its victims. The habits of these ought, in the treatment of the disease, to be made to resemble as much as possible those of the former class, as respects air and exercise, in order to effect a cure. How little does the plan of shutting up the patients in close rooms accord with this simple and obvious principle! As to the result of such a practice, it is known to all; one-fifth of the deaths annually in England are from consumption, whilst cures are scarcely ever heard of, and never expected. Despair seems to have taken full possession of the medical profession as regards this destructive disease, and none but the feeblest efforts are exerted to oppose its progress. The successful treatment of several cases successively of

severe, decided, and genuine tubercular consumption on principles, I believe, differing from the usual routine of practice, and from the doctrines and theories of the present day, which form the basis of medical practice, induces me to lay those cases before the public, and to explain my views and principles of treatment on which that success was founded.

"I come now to the most important remedial agent in the cure of consumption, that of the free use of a pure atmosphere; not the impure air of a close room, or even that of the house generally, but the air out of doors, early in the morning, either by riding or walking; the latter when the patients are able, but generally they are unable to continue sufficiently long in the open on foot, therefore riding or carriage exercise should be employed for several hours daily, with intervals of walking as much as the strength will allow of, gradually increasing the length of the walk until it can be maintained easily several hours every day. The abode of the patient should be in an airy house in the country; if on an eminence the better. The neighborhood chosen should be dry and high; the soil, generally of a light loam, a sandy or gravelly bottom; the atmosphere is in such situations comparatively free from fogs and dampness. The patient ought never to be deterred by the state of the weather from exercise in the open air; if wet and rainy, a covered vehicle should be employed with open windows. The cold is never too severe for the consumptive patient in this climate; the cooler the air which passes into the lungs, the greater will be the benefit the patient will derive. Sharp frosty days in the winter season are most favorable. The application of cold pure air to the interior surfaces of the lungs is the most powerful sedative that can be applied, and does more to promote the healing and closing of cavities and ulcers of the lungs than any other means that can be employed; for it is by the use of the means which have the power of restoring to a healthy condition the nervous system, interwoven with and forming a portion of the substance of the lungs, that healthy actions can be induced in the remaining tissues. This, then, is to be aimed—a healthy nervous system, which will embrace in its consequences, due sensibility, motive power, nutritive and reparative power—conditions necessary to resist and overcome the morbid influence arising from the presence of tuberculous matter. Many persons are alarmed and deterred from taking much exercise in the open air, from the circumstance of their coughing much on their first emerging from the warm room of a house; but this shows that the air of the room was too warm, not that the common atmosphere was too cold. To live in a temperature nearly equal to the latter at all times should be the aim of the patient, who should avoid warm close rooms

as much as possible, and always keep away from the fire, taking care to keep the surface of the body warm by sufficient clothing. Thus the equal temperature so much considered, and said to be necessary, should be that of the external air, instead of that so commonly employed, the warmth of a close room. * * *

"The next opportunity I had of witnessing the advantages of the mode of treatment described occurred in the case of a young lady, about sixteen years of age, whose parents, brothers, and sisters were all at this time healthy generally; consumption was not known in the family previous to her case, but at the present time her brother suffers from the disease. For several years she had suffered occasionally from pain in the side, cough and debility. In 1835 she returned home from a boarding school, where she had been placed under medical treatment for these complaints; she was still ill, and her friends thought it advisable she should go to the sea-coast. She went to Liverpool; the sea-air had a bad effect, the pain and cough increased; she was placed under medical care, and went through a long course of treatment. She continued to get worse in every respect, and her friends saw the necessity of her removal home; and she came to her native air in Warwickshire in October, 1835, after an absence of several months. Her friends were impressed with a notion that the iodine which she had been taking, if persevered with, would be ultimately successful. This very interesting patient came under my care. Her parents, relatives, and numerous friends were watching her with the deepest solicitude; for she was, by all who knew her, most highly and justly esteemed. I found it necessary, at least for a short time, to acquiesce in the treatment by iodine, although there was but little hope of any advantage from it. I met several medical men in consultation, and a treatment was pursued in the usual manner; the patient being confined to her room, and consumption gradually wearing her away. I had explained my views to her friends respecting air and exercise out of doors, but could not succeed in gaining their consent to the plan. The two months of November and December were thus lost to the patient, or rather, during that period every symptom of the disease had become aggravated; she was now extremely emaciated, suffered from profuse night perspiration, violent cough, and difficulty of breathing; the expectoration was abundant, consisting of mucus mixed with opaque solid portions frequently tinged with blood, most of which sank in water, some floated. There was a dull sound on percussion of the upper portion of the lungs, mucous rattle, with a gurgling noise, and a hoarseness, and weakness of voice; the physical signs, in combination with the general symptoms, were clearly indicative of the

existence of cavities in the upper portion of the lungs. In the month of January, 1836, the case was left entirely to my management; and, having urged my views strongly to her friends, I gained their consent to their being adopted. A donkey was procured, on which the patient began to take exercise out of doors, notwithstanding the inclemency of the season, in the depth of winter. The first trial was unpromising; the cough appearing to be much increased in coming into the open air from the warm bedroom. This arose from the undue closeness and heat of the bedroom, and not the external air. There cannot be a more fatal error than that which arises from the supposition of there being something deleterious in the external atmosphere, because persons cough when first brought into it out of unwholesome heated apartments. The latter should be especially avoided, and apartments kept cool and airy, corresponding in temperature nearly to the external atmosphere, whilst the former should be courted and indulged in to the utmost. The surface may be and should always be kept warm by sufficient clothing, the lungs cool by the constant access of cold pure air to them; thus undue heat is driven from the interior to the surface. In the present instance it was soon found that by continuing a long time out of doors the cough abated materially; every day some improvement was observed to take place, very gradual, but constant. A sedative draught was given every night, which, together with the exercise of the day, procured sleep and warded off the cough until morning. In the day time an emulsion was taken at intervals. and very small doses of morphine, to subdue by degrees the irritation arising from the presence of tubercles in the lungs. The diet was nourishing, consisting of boiled egg, fresh meat, milk and bread, and two glasses of sherry in water daily. This treatment was continued very strictly through the winter and spring months of the year 1836; by June the patient had entirely lost her cough, with all the other symptoms of the disease, regained her health and strength, and passed through the succeeding winter in very good health, accustoming herself to go out of doors, walking or riding almost daily. At this time, July, 1839, she is in perfect health."

Nothing can be added now that would augment the words of the originator as to the value of fresh air in respiratory disease.

What value has climate? In the minds of patients certainly it is the first thing thought of when tuberculosis is mentioned. In the minds of physicians accustomed to the treatment of such patients climate is often considered a matter of little moment. The relative importance of methods of treatment from the viewpoint of the physician and the viewpoint of the patient differs about as follows:

| PATIENT'S VIEW | PHYSICIAN'S VIEW |
|---|---|
| CLIMATE. | REST. |
| SERUM (OF SOME KIND). | FOOD. |
| Medicine (of some kind). | AIR. |
| Exercise. | Climate. |
| | Medicine. |

The patient is disposed to go to a climate and let the climate do everything. This is the heart of the whole matter. If the patient would observe the essential rules—rest, fresh air and extra food—when the climate is reached the physician would be more willing to assent to the change. But if the patient has to work in the new environment he is worse off than if he stayed at home. Usually a patient can more easily make arrangements to rest and to be fed without work in his own home than in a strange place. The final decision as to climate is an economic one; if the patient is financially able to go to the new and favorable climate, and rest in bed under proper medical supervision with extra food, for one year (or more) then the decision should be in favor of climate. But if the patient, depending entirely upon the climate to arrest the disease uses all his resources to go to some favored locality, and arrives there with the hope of finding some light work, cannot afford good medical advice or good food, he had much better stay at home and take the important parts of the cure in his own back yard.

This being always understood, the question may be asked whether there is any scientific basis for the belief that climate is of value in tuberculosis. That question has been answered in the affirmative to my own satisfaction by Doctor E. S. Bullock and Doctor C. F. Sands. These men compared the results obtained at the government hospitals for tuberculosis located in an approved climate—at Fort Bayard, New Mexico, and Fort Stanton, New Mexico—with the results obtained at some well managed hospitals which are not located in especially advantageous (as to altitude) climates—the Adirondack Cottage Sanitarium, the Massachusetts State Sanitarium, and the Rhode Island State Sanitarium. These institutions were selected for comparison because aside from their differences in location as to altitude, they are (except for the Adirondack Cottage Sanitarium) public institutions, and the physicians would have no interest in making (even unconsciously) the reports look better than they actually were. (This I think is an extremely important point in this argument; every one knows how with the best of intentions, a deeply interested collector can influence statistics. In deciding whether a case is *Cured* or *Improved* or *Arrested*, for instance, the psychology of the observer is very important.) As an

additional safeguard the figures as given cover the experience of these institutions for several years. The figures for the cases reported cured are as follows:

| | NEW MEXICO INSTITUTIONS | EASTERN INSTITUTIONS |
|---|---|---|
| Incipient cases | 43 % cures | 42% cures |
| Moderately advanced cases | 11 % cures | 8% cures |
| Far advanced cases | 3.1% cures | 0% cures |

For the complete figures those interested are referred to the original paper. In general one may safely conclude that climate has a 1 per cent benefit for incipient and more for moderately and far advanced cases.

## DRY HOT CLIMATES FOR NEPHRITIS

It is the custom to send patients with nephritis, provided they can afford it, to Egypt during the winter months. Any similar climate such as Texas or Arizona will do as well. The design is to save the kidney the extra work of secreting urine during the cold weather when the skin is not functioning. Year round residence, however, is probably better.

An observer in Texas records that his perspiration amounted to a gallon during one day while his urine amounted to thirty ounces. There have been recorded some authentic cases of cure of chronic parenchymatous nephritis due to prolonged residence in Egypt.

The same climates are recommended for rheumatism, of the chronic forms, muscular rheumatism and neuralgias for obvious reasons.

Emphysema and chronic bronchitis or bronchiectasis is also benefited during the winter months by a change to dry warm stable climates. In these cases the temperature need not be so high.

## SEA AIR

Convalescent states, nervousness, insomnia, anemias, hay fever and asthma are all benefited by sea air or a sea voyage. Any change of climate is valuable for hay fever and for many forms of asthma.

## HELIOTHERAPY

Heliotherapy is the employment of the sun's rays for treatment. The high priest of it, in our day is Rollier, who has conducted his treatment in the Alps. He believes that the actual rays of the sun are the most valuable and that though heliotherapy may be carried out anywhere it attains its maximum efficiency at high altitudes. The reason

for this is obvious. At sea level the sun's rays have to penetrate through the whole thickness of the atmosphere. In cities it is filtered through layers of smoke and dust.

Working in the Alps Rollier treats tuberculosis of many forms, particularly scrofulous children with skin, gland and bone lesions. The illustrations which accompany some of his articles exhibit almost magical results in these cases.

Rollier has evidently rediscovered the truth in the old trick question the quiz master in anatomy used to ask: "What is the largest organ of the body?" The answer is, "The skin." He points out that Europeans are accustomed to regard with a complacent superiority the way less progressive peoples maltreat parts of their bodies—the way Chinese women, for instance, deform their feet—and to disregard the amount of insult they heap upon the skin by their treatment of it. All the functions of the skin are more or less interfered with by covering it with clothing. The sun's rays cause increased vasculosity of the skin and in time thickening and hypertrophy of it. It seems to increase adipose tissue beneath it and improve muscular development. These observations serve to explain the quite remarkable results Rollier unquestionably gets.

He describes a part of his technic as follows:

"Exposure always begins with the feet; the legs, thighs, abdomen, and thorax follow in this order with an interval of a varying number of days between each. Only a few minutes' exposure is allowed to each part on the first day of insolation; this amount is gradually increased until at the end of a period of time, which varies with each subject—degree of pigmentation and absence of excessive reactions being the criterion—the patient is able to expose the whole body to the sun for several hours daily without any inconvenience either in summer or winter. Secondary infection without free drainage, pulmonary and abdominal tuberculosis, are conditions in which increased caution is necessary. Far from contraindicating heliotherapy, however, they are greatly benefited by this form of treatment if properly carried out. Plaster apparatus is a great hindrance to heliotherapy and is almost invariably discarded, as not only does it interfere with the local action of the sun on the diseased part, but it also causes muscular atrophy, which is a great disadvantage when return of function begins, and compares most unfavorably with the thick covering of well developed muscle which is usual with heliotherapy, and forms an admirable support for a weakened vertebral column or joint. These cumbersome devices of plaster should be replaced by simple arrangements of webbing straps while permitting free access of air and sun."

Rickets is another disease which has been found to be due, partly at least, to lack of sunlight and to be curable, partly, by application of sunlight either natural or in the artificial form of the carbon arc lamp. This conclusion is supported both by observation and experimental evidence. For many years there has been controversy as to whether rickets was due to dietetic errors or hygienic defects. The work that has recently been done indicates that both have a part—that there is an antirachitic fat-soluble vitamine (found in cod-liver oil very abundantly) concerned, a phosphorus defect, and lack of sunlight.

Experimental work has been done largely on rats, which are very susceptible to rickets in a form much like the human form. Powers, Park, Shipley, McCollum and Simmonds showed that rats which were given a rickets-producing diet can be prevented from developing the disease by short and frequent exposure to the sun's rays. Rickets has a decided seasonal variation, occurring in the winter and spring months with great preponderance, due to the long indoors winter. In India Hutchinson and Shah have shown that rickets occurs, in one district, almost entirely among children of upper class Hindus. The diet of these children is better than those of the lower classes, but they are kept indoors more by religious restrictions and social customs.

Another interesting development of these conclusions is that the amount of pigment in the skin is an important factor in the development of rickets. White and black rats fed on the same diet and exposed equally to the sun's rays, showed a much greater preponderance of rickets among the black rats, and the greater incidence of rickets among negro babies would seem to be explained on this basis.

This is not to say that faulty diet does not play a large part in the production of rickets—rats fed on an ideal diet and kept in the dark do not develop rickets. But along with diet, exposure of the whole body to sunlight daily is the most effective treatment for rickets at the present time.

## MINERAL SPRINGS

A list of the best known mineral springs, baths and spas is appended below, with a notation of the kind of water and the diseases for which they are particularly recommended. This is done for the guidance of physicians who may be questioned by patients or asked to recommend certain springs. No critical comments are appended.

The benefit to be derived from a course or cure at a mineral spring depends, almost entirely, upon the efficiency of the medical organization thereat. The waters themselves, save possibly that when fresh they are radioactive, are of no more value than medicines compounded of

the same mixtures. But combined with rest, regular mild exercise, freedom from worry, a carefully supervised dietary and equally carefully supervised physical therapy in the forms of massage and hydrotherapy, they are of great benefit in many conditions. Conversely, a slipshod medical supervision may result in great harm.

In general there are about eight kinds of mineral springs used for medical purposes:

1. Hot springs, medicated or unmedicated.
2. Arsenic waters.
3. Sulphur waters.
4. Calcareous waters.
5. Common salt, muriated or chloride waters.
6. Alkaline waters.
7. Sulphurated saline waters.
8. Iron or chalybeate waters.

### The United States

**Poland Spring, Maine.**—Alkaline water used for diabetes and nephritis.

**Saratoga, New York.**—Saline and chalybeate waters. For dyspepsia, chronic constipation, engorgement of the liver, and anemia. The climate is stimulating, the season is from June to September. Strict medical supervision is not enforced.

**Clifton Springs, New York.**—The waters are sulphur and carbonic gas. The Clifton Springs sanitarium has always been distinguished beyond nearly any other medical sanitarium in the United States for the high degree of efficiency maintained in the professional staff.

**Richfield Springs, New York.**—The waters are heavily charged with sulphurated hydrogen and are used by inhalation for bronchitis and catarrh, and in the form of Russian and Turkish bath for nephritis and rheumatism.

**Dansville and Watkins, New York,** have good sanitaria equipped for the treatment of chronic diseases, particularly the Nauheim treatment of heart disease.

**Cambridge Springs, Pennsylvania.**—The waters are chalybeate calcic, magnesia and lithia. They are especially recommended for dyspepsia, hyperacidity and urinary diseases. There are several large hotels.

**Bedford Springs, Pennsylvania,** is a mountain spa. The springs contain alkaline and chalybeate waters. They are used in constipation, dyspepsia, nephritis and diabetes.

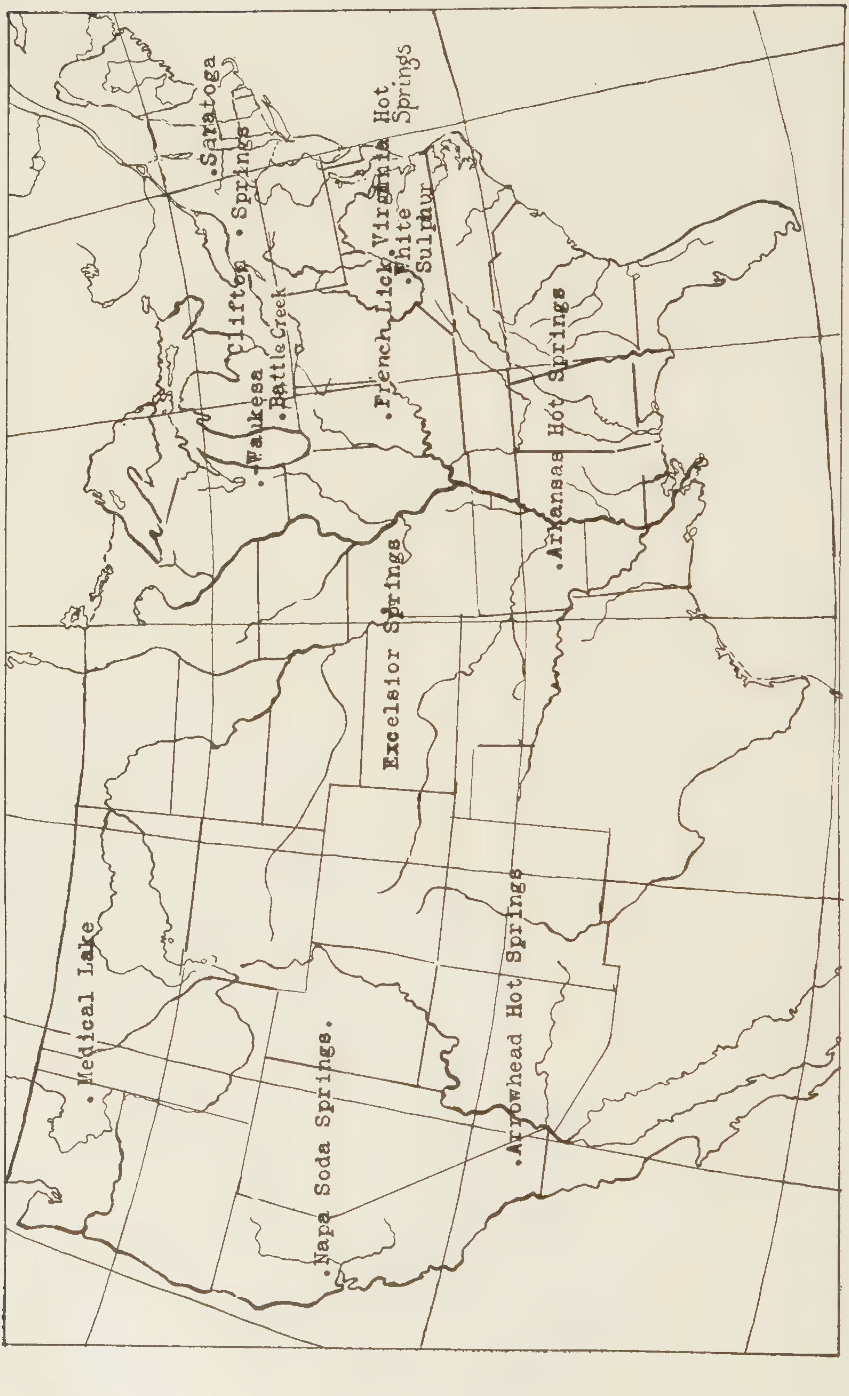



Fig. 36.—Map showing location of some important mineral springs of the United States.

**Strontia Springs, Maryland.**—Muriated alkaline waters, used as tonic, diuretic and alterative.

**Mardela Springs, Maryland,** has iron and arsenic waters used for anemia, dyspepsia, cystitis and functional pelvic disorders of women.

**Buffalo Springs, Virginia,** have lithium, carbonate and gaseous sulphur springs.

**Hot Springs, Virginia.**—The waters are alkaline, earthy and sulphated. The temperature of the water is 106 to 108° F. They are used for chronic rheumatism and gout.

**Sweet Chalybeate Springs, Virginia.**—Earthy chalybeate waters used for anemia, leucorrhea and neuralgia.

**Rockbridge Alum Springs, Virginia,** and **Jordan Alum Springs, Virginia,** are acid chalybeate and aluminous. Used for catarrhal inflammations.

**Greenbrier White Sulphur Springs, West Virginia.**—Sulphur and chalybeate springs. The most luxurious of hotel accommodations. Every variety of baths and physical therapy. The season is spring and fall but is not unpleasant the year round. The waters are used for affections of the skin, liver, kidneys and for catarrhal affections of the nose and throat. The hot sulphur baths are used for rheumatism and gout.

**Check's Springs, South Carolina.**—The waters are gaseous and chalybeate. Used in dyspepsia and hepatic torpor.

**Glenn Springs,** near **Spartanburg, South Carolina.**—Alkaline waters used for dyspepsia and functional pelvic disorders of women.

**Indian Springs, Georgia,** are sulphurous and laxative and used for jaundice, rheumatism and gout.

**Warm Springs, Georgia,** has sulphur and iron springs of a temperature of 95° F. They are used for skin affections, rheumatism and gout.

**Mineral Wells, Texas,** has several springs mostly of alkaline, saline and sulphur waters.

**Blue Lick Mineral Springs, Kentucky.**—Muriated sulphur waters charged with carbon dioxide and hydrogen sulphide, used in dyspepsia, gout, constipation, rheumatism and skin diseases.

**Fountain Park Magnetic Springs, Ohio,** are muriated alkaline springs.

**Erckenbrecker's Salt Wells, Ludlow Grove, Hamilton County, Ohio,** have a strong brine for external use.

**French Lick Springs, Orange County, Indiana,** has muriated sulphur waters, alkaline waters and saline waters. They are used for consti

pation, liver and stomach disorders, urinary diseases and affections of the nose and throat. There are several very good hotels.

**Mudlavia, Attica, Indiana,** has good mud baths and fango baths used in rheumatism, gout, sciatica, eczema, etc.

**Sulphur Lick Springs, Wedron, Illinois.**—Alkaline waters, for diabetes, rheumatism, gout, neuritis, stomach disease and high blood pressure. Good hotel.

**Green Lawn Springs, Jefferson County, Illinois.**—Muriated chalybeate waters.

**Mount Clemens, Michigan.**—The springs are strong sulphuretted brines. They are used both externally and internally for rheumatism and neuralgia. The accommodations are good; in the town there are several bath houses; medical supervision is reasonably available and it has much the air of a European Spa.

**Battle Creek, Michigan,** has a sanitarium which for many years has had a hydriatic institute of the highest grade. Owing to the large number of patients who came there it became necessary to put in a full medical staff with surgical and other special consultants. The staff is of a very high order of competence.

**Waukesha, Wisconsin,** is one of the best known American spas. There are several springs, the water containing largely magnesium and calcium bicarbonate. Good medical supervision is available; the hotel accommodations are excellent. The waters are recommended in diabetes, nephritis, cystitis, other urinary disorders and gout.

**Hot Springs, South Dakota,** is at an altitude of 3500 feet and has 75 mineral springs containing sodium, potassium, magnesium, calcium, carbonates and phosphates. There are ten hotels and bath houses. It is well designed for pulmonary and bronchial affections and chronic rheumatism and urinary disturbances.

**Excelsior Springs, Missouri.**—Iron and sulphur saline springs. Several good hotels. The waters are used for diabetes, nephritis, chronic constipation, and gall bladder affections, and mild digestive disturbances. There is no well organized medical supervision in the hotels although good medical advice is available in the town.

**Hot Springs, Arkansas.**—There are 70 springs, containing calcium carbonate and silica with a temperature of 148°F. The United States Government exercises supervision over the waters and maintains a hospital here for men and officers of the army and navy and also a free bath house. The hotel and private bath house accommodation is excellent. The principal spring water for drinking purposes is mountain valley water, recommended for rheumatism and nephritis.

The medical supervision is probaby closer and better than at any other American spa. Patients going there should be directed to consult some particular physician. The springs are used chiefly for rheumatism and as an adjunct to the treatment of syphilis. By pushing antiluetic treatment and using hot baths internally and externally enormous dosage is permissible.

**Las Vegas Hot Springs, New Mexico,** are mild chloride and sulphur waters. There is a good hotel and a good sanitarium. Mud baths are used in the treatment of rheumatism. The altitude is 6400 feet.

**Glenwood, Colorado,** at an elevation of 5600 feet, has about 50 thermal mineral springs with carbonic acid and sulphuretted hydrogen gas. The temperature of the water is 127° F. They are used in rheumatism, dyspepsia, hepatic torpor, syphilis and skin diseases.

**Salt Lake City Hot Springs Sanitarium, Utah,** utilizes the heavy brine waters charged with sulphuretted hydrogen for baths.

**Castle Hot Springs, Arizona,** is at an elevation of 2300 feet. The waters are alkaline at a temperature of 115° F. and are used for rheumatism. There are good hotel accommodations.

**Arrowhead Hot Springs, California.**—Hot vapor baths. Good hotel accommodations.

**Napa Soda Springs, California,** are alkaline chalybeate and used in anemia, chlorosis, nephritis and cystitis, located in a delightful spa.

**Gilroy Hot Springs, California,** are gaseous, alkaline and sulphuretted, temperature 115° F. and used in scrofula, rheumatism and skin diseases.

**Harbin Hot Springs, California,** in Lake County at an altitude of 2000 feet, are used, like other gaseous sulphuretted saline chalybeate waters, for anemia, chlorosis, rheumatism, arteriosclerosis and convalescence. The resort is delightful in climate and scenery.

**Highland Springs and Clear Lake, California,** are in the same county and have the same sort of springs.

**Klamath Hot Springs, California,** is at an elevation of 2700 feet, with good hotels and bathing facilities and alkaline saline and sulphur waters, used in chronic rheumatism, gout, joint diseases, skin diseases, and dyspepsia.

**Wilhoit Springs, Oregon,** are alkaline waters useful in chronic gastric catarrh and nephritis.

**Medical Lake, Washington,** is a resort used for the treatment of rheumatism and skin diseases. The waters are earthy alkaline and chalybeate.

### English Spas

**Bath.**—The waters have a temperature of 104° F. containing calcium sulphate and other earthy alkalies. They are used chiefly externally in cases of gout, rheumatism, sciatica, digestive and nervous diseases.


Fig. 37.—Map showing location of important mineral springs of Europe.

**Droitwich** has brine baths used for rheumatism, neuralgia and myalgia.

**Harrogate** has a number of mineral springs of the cold muriated group. It is excellently supplied with hydriatic institutions and the

medical supervision is probably the best in England. The waters are recommended for liver disease, gout, rheumatism, obesity, skin diseases, anemia, etc. The season is from April to November.

**Leamington** has 4 springs of a sulphurous and chalybeate character. They are used for gout, rheumatism, lumbago, scrofula, anemia and liver disease. There are many good hotels. As a point of interest it is within a day's ride of Stratford, Warwick, the George Eliot country, Coventry, Kenilworth and Oxford.

**Royal Tunbridge Wells** has chalybeate and saline waters, recommended in cardiac diseases, obesity, neurasthenia, anemia and debility.

### France

**Vichy.**—Has many simple alkaline springs, several of them thermal. They are under the control of the French Government, and are used for dyspepsia, gastritis, gout, diabetes and intestinal affections.

**Aix-les-Bains.**—A very famous watering place with palatial hotels and bathing establishments. The waters are both hot and cold sulphurous, the temperature of the thermal springs being 108° to 112° F.

**Spa in Belgium** has iron waters designed for anemia, etc.

### German and Austrian Mineral Springs

**Aix-la-Chapelle.**—Thermal muriated sulphur waters, with excellent bath houses. It has established a well known treatment for syphilis.

**Carlsbad, in Bohemia,** was probably the most famous mineral spring health resort in the world before the World War. The waters contain sodium sulphate, sodium bicarbonate, and sodium chloride. The medical supervision in the old days was splendid. The treatment consisted of walking, careful dieting and judicious use of the waters. Obesity, liver diseases and particularly gall bladder affections were treated. The patients were often sent to **Pyrmont** or **Schwalbach** afterwards for a course of iron waters.

**Marienbad** is much like Carlsbad and not far from it.

**Ems** is the great resort for opera singers and those who have throat and nose affections. Special places designed for gargling and nasal douching are arranged.

**Wiesbaden** has hot muriated waters used for chronic rheumatism, gout and neuralgias. A system for treating syphilis is in operation.

**Homburg** has alkaline and iron water used in gout and anemia.

**Nauheim** has gaseous thermal muriated waters used in heart disease.

**Baden-Baden** is situated in a beautiful part of the Black Forest; it has weak thermal muriated waters used in chronic catarrhal affections of the respiratory tract and chronic rheumatism.

**Kissingen** has cold gaseous muriated waters of about the same quality and same uses as those of Homburg.

## References

Bullock and Sands: Twelve Years of Pulmonary Tuberculosis Treatment in the West, Jour. Am. Med. Assn., June 19, 1909, lii.
Hess: Newer Aspects of the Rickets Problem, Jour. Am. Med. Assn., April 22, 1922, lxxviii, No. 16.
Huntington, Ellsworth: Civilization and Climate, 1915.
Hutchinson and Shah: Etiology of Rickets, Quart. Jour. Med., January, 1922, xv, 167.
Rollier, A.: La Cure de Soliel.
Rollier, A.: Lancet, March 19, 1921.
Sewall: Chapter on Climate in Vol. i, Oxford Medicine.
Solis Cohen: A System of Physiologic Therapeutics, Philadelphia, P. Blakiston's Son & Co., Vols. iii and iv.
Webb and Williams: Trans. Nat. Assn. for Study and Prevention of Tuberculosis, 1909, p. 231.

# CHAPTER XII

## PSYCHOTHERAPY

"The principal grievance which I have against the doctors is that they neglect the real problem, which is to seize the unity of the individual who claims their care. Their methods of investigation are far too elementary; a doctor who does not read you to the bottom is ignorant of essentials. To me the ideal doctor would be a man endowed with profound knowledge of life and of the soul, intuitively divining any suffering or disorder of whatever kind, and restoring peace by his mere presence. Such a doctor is possible, but the greater number of them lack the higher inner life, they know nothing of the transcendent laboratories of nature; they seem to me superficial, profane, strangers to divine things, destitute of intuition and sympathy. The model doctor should be at once a genius, a saint, a man of God."—Amiel.

Psychotherapy is the term we shall use to designate those methods of treatment which aim to help a patient by adjusting his personal viewpoint to his problems. No very satisfactory definition can be made for it. Intrinsically it means treatment of the soul. And the soul may be sick because the body is sick, or because the individual's life has gone awry, or because he views the outside world and its relations to himself through distorted lenses. Therefore psychotherapy is applicable to physical disease, to psychic or mental disease or to social maladaptations.

Psychotherapy recognizes that there is a person who has the disease as well as the disease itself. It sees that to a symptom—pain—there are two elements: the pain itself and what the patient thinks about the pain. It is aways possible to control to some extent the latter element. Thus psychotherapy can be used, is used, must be used by every physician in every disease. Encouragement, hopefulness, the instillation of confidence and courage are all forms of the best kind of psychotherapy.

But it is much more than that. Psychotherapy recognizes that there are symptoms whose origin is purely psychic; that whole diseases and syndromes are due, not to any organic disease, but to the patient's mental habits or bias. It believes and it believes passionately that physical treatment of these disorders is absurd, and wastefully ineffective, that in point of fact it simply leads to the return of the symptoms after a temporary betterment.

The profession as a whole is more indifferent to, and neglectful of, psychotherapy than any other form of therapeutics. Especially is this

true of the conscious application of psychotherapy. For this neglect there are, it seems to me, several reasons:

*First.*—The tendency of the profession is largely mechanistic. It seeks to explain all disease upon an organic basis. Or if the word organic has an anatomical connotation we may call it somatic or vegetative. In obscure disorders it is inclined to seek for the cause in some such thing as a dysfunction of a ductless gland, a focal infection, a displacement of the uterus, eye strain, masked tuberculosis, intestinal stasis, etc. Every man has had enough "neurasthenic" cases which proved to be one of these things to make him feel that most cases will fall into some such category. Men are unwilling to make a primary diagnosis of "neurasthenia" or of "a neurosis." When they make such a diagnosis they apologize for it. They say, "This patient has neurasthenia, *if there is any such thing,*" or "I suppose one shouldn't make such a diagnosis without trying other things."

Now whether it is called neurasthenia or some other name, there certainly are a very large number of cases, amounting, I should say, to the largest single group with which the physician has to deal, who are sick primarily not because there is something wrong with their bodies, but because there is something the matter with their minds, their viewpoints, their souls. It is perfectly proper to recognize them and to make such a diagnosis primarily, and the proper treatment is to apply psychotherapy. Of course, with fallible human minds, and fallible human instruments there will be some mistakes, and some of these cases will turn out to be organic. Such mistakes, I believe, are not nearly so frequent as the other sort, i.e., treating patients with psychic disorders as if they had a physical disease.

*Second.*—The mental and spiritual equipment of the average practitioner is inadequate to the demands of psychotherapy. This is not meant disparagingly—I regard it upon the whole as a good thing. But for better or for worse, physicians see so much of real suffering that they are inclined to be rather impatient and scornful of those whose suffering is self-induced. Thus they are unsympathetic and this immediately alienates the nervous patient. Furthermore most of them are not primarily designed, they have not had sufficient spiritual experience, it seems to me, to understand the tenuous intricacies of such a patient's tribulations. The worst of it is that this makes them scornful of those who do wish to try to understand and help.

*Third.*—Psychotherapy is too hard work. It is a good deal easier even after the case is frankly recognized as being a neurosis, to prescribe a bromide, or a course of massage, or of hydrotherapy, or tell the patient to take the rest cure, than to sit down and really dig into the

mental life of the patient and devise some reasonable form of help. Some forms of psychotherapy, indeed, are so technical in character that only a special practitioner can apply them, as for instance psychoanalysis and hypnotism.

But, while they may not feel that they wish to try to apply psychotherapy themselves, practitioners should try to overcome the contempt which they seem to feel for psychotherapy. If for no other reason than that the profession is continually losing patients to Christian Science this is true. It will be the purpose of this chapter to outline the methods of psychotherapy and particularly to stress those forms which are suitable for the general practitioner.

There are five forms of psychotherapy:

1. Suggestion or sidetracking.
2. Rest cure.
3. Hypnotism.
4. Psychoanalysis.
5. Education, reeducation and explanation.

**1. Suggestion or sidetracking** is probably the method most frequently used and upon the whole the least stable of all psychotherapeutic methods. For instance, the use of placebos is a form of suggestion: the patient thinks he is getting a drug and the suggestion makes him feel better. Religious and "miraculous" cures are of this character. The darkened church, the stillness, the constrained attitude, the air of mystery, the closed eyes—all these accompaniants of religious service cure and sometimes cause mystical nervous disorders. Every physician has some experiences illustrative of cure by suggestion.

A neurotic Jewess choked upon a bolus of food and for months afterwards had a feeling of a lump in the throat and spoke only in a whisper. One day her physician called upon her during the time when the table was set for lunch. While she was out of the room he took a piece of bread wadded it up in his hand and moistened it with water. When the patient returned to the room he said, "Let me look in your throat once again." When she opened her mouth he said, "Ah!" in a very triumphant voice and produced the wad of moistened bread apparently from her throat. Her symptoms immediately cleared up.

A singer after a fright in an automobile became completely aphonic. She could not even whisper. She was induced "to make a noise with her nose" by pinching her nostrils with her thumb and forefinger and squealing. The sound, of course, originated in her larynx. But she supposed it was done with her nose, and under that impression tried it. As a result she squealed a shrill squeal. When it was explained to her that the sound was made in her larynx she got a complete cure of her aphonia.

The objection to suggestion is that it is not entirely honest: the patient is really fooled. No psychic method should have that element in it.

**2. Rest Cure.**—The rest cure was designed by Wier Mitchell to treat nervous disorders by taking the patient away from all irritations—family contacts, the visits of friends, and social or business obligations

For certain persons it is well designed—and, as a matter of fact, peace procures for all neurotics an immediate relief. The sort of person for whom the rest cure is well designed is the one whom the world irritates; who finds slighting remarks in casual conversation, discouragements in any undertaking, and despair in the surmounting of difficulties. For such a one, peace and protection are well designed to nurse him back.

But the rest cure is not a panacea. We have had, I believe, too simple a conception of nervous disease. The word neurasthenia—tired nervous system—has contributed to this. A prominent symptom of these people is fatigue, and we have been taught to believe they are fatigued because they do too much. But it is not so. They are fatigued because they do too little. It is not the captain of industry or his lesser brother in business affairs, constantly busy and interested, a member of half a dozen boards and committees, who breaks down and has nervous prostration. It is the lady who has not even the management of her own house or child. I have been interested in one particular example of that. A business man of introspective tendencies was a constant frequenter of neurologist's offices. He was several times psychoanalyzed and was much perturbed over his complexes. During this time his business was getting along perfectly, was prosperous, and needed almost none of his personal attention. But when the wave of business depression in 1920 came along he found that it was necessary for him to put his shoulder once more to the wheel—to plan, to execute, to assume responsibility, to get to the office early, to stay late. This did more for him than all the neurologists. He lost his complexes.

**3. Hypnotism.**—Hypnotism is a state of semiconsciousness induced by the rhythmic stimulation of a single sense, when all the other senses are at rest. The regular tapping of a gong, while the body is lying in a darkened room, the rhythmic flashing of a light in the eyes—will induce the hypnotic state. When hypnosis has occurred, suggestion is made to the patient which is carried out in the waking state.

As a method of therapy it is no longer greatly used. It is unsafe and unsatisfactory.

**4. Psychoanalysis.**—This method, introduced by Freud, has become so generally known, so many popular expositions of it can be had at any bookseller's, that it bids fair to be taken out of the hands of the profession entirely. We hear of psychoanalysis all about us. The intelligentsia analyze themselves, and write plays and novels upon psychoanalytic themes; college courses are administered upon it, and women's clubs consider it with the episcopal dignity that is habitual with them.

The origin of the method is interesting and contains the most valuable part of its final form. In 1882 while working in the Neurologic

Hospital of Breuer in Vienna, Freud was assigned to a patient, since famous as "Dora." She had tried to pour out her troubles to Breuer himself, so the story goes, but he was either too busy or too bored to listen to her, and turned her over to Freud. Freud listened to her story: she talked and talked: she told him all about her queer feelings, her experiences, her misunderstandings, her long forgotten life and repressions. She talked, evidently for hours, or for days. And the young neurologist sat and listened to her. He made no effort to stop her. He made no effort to criticize her. He was unmoral. He was, using that strange poignant phrase he himself coined, not censorious. She could talk to him about the most intimate things, with perfect frankness and honesty, she could tell him the actual truth, even more honestly than she told it to herself, and he would sit there impassively, not shocked, not even astonished. When he visited her again, to his surprise she was better. She said that she wanted to talk some more—that "talking things out" had done her a great deal of good. From this came the beginning of the therapeutic method of "catharsis"—clearing the mind of stagnant matter and foreign bodies by making a clean breast of it.

This part, perhaps the most valuable part of Freud's doctrine, is in reality familiar enough as a commonplace piece of psychology. It is the secret of the confessional. It does anyone good to tell all his troubles: the mere talking about them lightens the burden. It even helps to solve them: the crystallization that comes with statement makes a half repressed, half conscious horror seem less grisly. Methods of escape, of solution, formulate themselves with the definition of a problem.

But this is not the only fact that Freud learned from "Dora." He began to see that painful mental experiences tend to be thrust down into the subconscious mind; we say they are forgotten; but nothing, Freud came to believe, is ever really forgotten; it is simply thrown out of consciousness into subconsciousness. The more painful the mental experience is, the less it is likely to be forgotten, and the more likely it is to come *bubbling up into consciousness,* but when it comes bubbling up it is translated—translated into an hysterical convulsion, into a paralysis, a melancholia, a fatigue, dreams, dyspepsia, into the commonplaces of daily life, into jokes, slips of the tongue, etc.

This development of ideas came later. At first Freud was sufficiently stimulated to question other patients. And as he did so his original ideas became strengthened, and another—a curious conception took hold of him. The more painful the mental experience, he had said, the more likely was it to be thrust down into subconsciousness, and the more likely too it was to bubble up later into consciousness. But as time went on, as he talked to more and more patients, it became impressed

on him that the only very painful experiences men and women had were in connection with their sexual life. The word "sex" was used by Freud in the most catholic sense, meaning infantile and childhood experience, the love of children for parents, of brothers for sisters, and every variety of natural and unnatural sex emotion. He pointed out, in his later work, that the love of a child is more likely to center upon the parent of the opposite sex, and to give rise to jealousy of the other parent, initiating in this way a long psychic conflict—the so-called Oedipus complex. Freud finally stated the matter by saying that, while other emotions might be strong enough under certain conditions to cause symptoms, he had yet to find any except those in the sexual life of the individual which *did* cause symptoms.

The translation that the hysterical patient makes of these repressed sexual experiences is symbolical. It may be just the opposite of desire. The Freudian wish may cause a young woman who wishes some particular young man to kiss her, to state that she hates him. It attains its most perfect expression in the symbolism of dreams. In discovering the causes of a patient's symptoms Freud found the relation of his or her dreams to be a most valuable guide, and the symbolism of dreams and their interpretation came to be a most important pillar of his doctrine.

Freud's first paper on hysteria was published about 1895. Many others followed. He formulated his ideas also in several books. Most of them have been translated into English. "The Interpretation of Dreams," probably contains the most complete statement of his ideas. An American edition of some of his work is published under the title of "Selected Papers on Hysteria." "The Psychopathology of Everyday Life" is a Freudian interpretation of the most ordinary commonplaces of existence. "Wit and the Unconscious," one of the most humorless volumes ever penned, is a laborious attempt to dissect the cause of laughter; no person with the vestige of a sense of humor could possibly have been responsible for it.

These volumes represent the original, and it may be added the most dependable, parts of Freud's doctrine. His disciples modified or extended that doctrine in various ways. Jung, the most notable of them, applied it extensively and practically to the association of ideas. Adler also broke away from a strict adherence to the orthodox Freudian doctrine. His theory of hysteria is that the fundamental psychologic element in the neuroses is a feeling of inferiority which the neurotic possesses, and which in every case originates and is founded upon an inferior organ. The neurosis consists in the attempt on the part of the individual to overcome this inferiority—this attempt being desig-

nated the flight to safety. Others have carried the ideas out and applied them to many fields of research. Folk-lore and mythology have received much attention; and it has seemed quite logical to find complexes having a sexual connotation in the instinctive ideas of the race, "hopes and fears as old and new as Nature's self." Naturally enough, comparative religion has had the same searchlight turned on it; with the result that such a book as Rank's, "Myth of the Birth of the Hero," is a heresy so devastating that it makes the minor infidelities of Darwin, Huxley, Renan and Straus seem like the babblings of a freshman coed trying to impress a free thought poet at a faculty tea.

Summing it up, Freud made, first a very solid contribution to psychology; he did that science the tremendous service of making it synthetic rather than analytic. He produced too a theory of the neuroses and a method for their treatment.

The substance of this theory has been summarized by one of the sanest of his American followers thus:

"1. There is no *chance* in mental life; every mental phenomenon—hence every nervous phenomenon—has a cause and meaning.

"2. Infantile mental life is of tremendous importance in the direction of adult processes.

"3. Much of what is called forgetting is rather a repression into the subconscious, of impulses which were painful to the personality as a whole.

"4. Mental processes are dynamic, insisting on discharge, either in reality or in phantasy.

"5. An emotion may become detached from the idea to which it belongs and be displaced on other ideas.

"6. Sex interests dominate much of the mental life where their influence is unrecognized. The disturbance in a psychoneurosis is always in this domain of sex life. 'In a normal sex life, no neurosis.' If a shock is the precipitating cause of the trouble, it is only because the ground was already prepared by the sex disturbance."

*Jung, Adler* and *Meyer,* the first two of whom were once disciples of Freud, have all elaborated independent ideas with Freud's general theme as a basis. Freud has not been by any means satisfied with these attempts at embroidery of his theme.

Jung changed the conception of the libido. The libido in the psychologic sense is the impulse to life, the wish, the hopes, the cravings, whatever they may be, which constitute the mainspring of action. To Freud this was entirely sexual. Sexual emotions, desires, and experiences contain the chief interests in life and causes of shipwreck. Jung conceived

of the libido as a universal force representing every possible form of vital activity. Freud says the libido drive is always fundamentally sexual. Jung says it can be compared to energy: and just as there are different kinds of energy—heat, light, sound, electricity—so there are various forms of libido—love, hunger, fear of death, avarice. Each individual organism has some of these libido cravings which are part of the same sort of libido cravings which belong to every one in the world. Jung formulated as his second idea a collective psyche, divided into the collective spirit and the collective soul. This brought him to a somewhat modified idea of the unconscious. Freud's theory of the unconscious was that everything in it was once part of consciousness and had been thrust into unconsciousness on account of painful (sexual) experience. But Jung believes that "it comprehends not only suppressed elements but also all the psychic elements which have not attained the level of consciousness." The elements which have not attained the level of consciousness may be parts of the activities of the collective psyche. The individual according to Jung is a principle that is opposed to the collective psyche and from this conflict between the individual and the collective psyche spring the individual's psychoneuroses. Jung was responsible also, I believe, for making the very interesting classification of individuals into introverted and extroverted. The introverted are the introspective, nonsocial, shy, timid, bashful, subjective types, while the extroverted are the action-loving, social exhibitionist, objective types.

Adler's main contribution to the general method was what has come to be called "the inferiority complex." He pointed out that just as many adjustments of the physical organism may be due to an inferior organ, so in the mental world an inferior organ or tendency, either imaginative or real, leads to adjustments by the individual. These adjustments may be, and in Adler's opinion usually are, overcompensations; for instance, the classical illustrations Adler uses are Beethoven, who was deaf, producing wonderful music, and Demosthenes, who stuttered, becoming the greatest of orators.

Meyer has published some very interesting, and to me valuable, work which synthesizes many of these varied views. He has made an "Analysis of the Neurotic Constitution" and divides it into 6 classes:

1. The Psychasthenic Type. In the sense of Janet, i.e., the individual with manias, phobias, scruples, etc.

2. The Neurasthenic Type. The individual who is quickly fatigued and easily irritated.

3. Hypochondriasis, usually built on a feeling of ill-health which leads to self-observation and explanation.

4. The Hysterical Constitution. The emotional individual who simulates illness, or exaggerates real difficulties; who craves attention

and contrives to bring his sickness into prominence in the presence of others.

Of hysteria, Professor Meyer writes, "I am inclined to refer to hysteria all the mental and physical disorders which are produced by the effects of an emotion or idea which may work unconsciously to the patient, so that the simulation claimed by others is usually beyond the control of the patient, and the whole explanation is but accessible on hypnosis." Schizoid types also belong here.

5. The Epileptic Constitution manifesting periods of excessive irritability between the characteristic attacks.

6. "Certain Types."

a. The unresistive—responding easily to fever, to intoxication.
b. The maniacal-depressive.
c. The paranoic—the suspicious individual with a tendency to self-isolation and to read a deep meaning into the most ordinary events.
d. The deterioration type (dementia precox). The easy-going individual who avoids conflicts, who suffers injury, and who is meek and humble—simply because he has not the energy and initiative to protest. He is likely to moralize, delineate standards that he cannot attain till ideals are all but achievement. The final state of such an individual is one of marked deterioration.

His psychologic method of therapy consists in, first, an intimate study of the living personality of the individual; second, a study of the difficulties or conflicts under which this individual has labored; and, third, the type of reaction he has manifested in dealing with his difficulties.

The technic of psychoanalysis is not easily acquired. The practitioner is dealing with the stuff of human personality, a very dangerous medium in which to work. He must be first of all a man of very great wisdom, richly steeped in human experience—he must himself have a very sound soul. Furthermore, he must have enormous amounts of sympathy and patience and restraint. Such things obviously cannot be taught.

But unless a man feels that he has some measure of these qualities, unless he is tremendously interested in these problems and is under a strong call to do this work, he had best content himself with other methods of psychotherapy. I can say this with some grace, because I do not myself attempt to practice psychoanalysis. Yet I feel strongly that the general practitioner should use forms of "minor psychotherapy" just as he uses "minor surgery." Dr. Karl A. Menninger, himself a practitioner of psychoanalysis, calls the first three methods I have mentioned—suggestion, rest cure and hypnotism—suppressive measures, while psychoanalysis and re-education constitute expressive measures. Of these psy-

choanalysis is far more thoroughgoing than re-education. For general use, for the great majority of patients who need psychotherapy, whether their diseases be organic, functional or social, and for the great majority of practitioners, the repressive measures, or the mild expressive methods of re-education are the best, safest and most satisfactory forms of psychic treatment.

These preliminary problems of the selection of the practitioner and the selection of the patient for psychoanalysis are perhaps the most important parts of the technic. If you had a furuncle on the skin of your abdomen you would not employ the local butcher to open it, nor the greatest abdominal surgeon in the world; or if you employed the greatest abdominal surgeon in the world you would not expect him to open the peritoneum in order to get at the seat of the trouble. Much the same sort of thing can be said about psychoanalysis. Its practitioners often try very elaborate methods on very simple conditions.

Assuming, then, that we have a properly selected patient for psychoanalysis and that we have a properly qualified pyschotherapist, how does he go about treating the individual case?

First, the patient should understand something of the nature and objects of the method. He should understand that it is a long process, that interviews will extend over many months and progress will take place slowly. Secondly, a complete understanding as to fees and finances should be arrived at. Then the general objects of treatment should be explained. Cure, in the sense of complete change, need seldom be expected. Adjustment is a better word—a reconciliation of the patient's capacities to his life and its needs. The patient must be reassured thoroughly either that there is no obscure organic disease which is the cause of his symptoms, or that, if his symptoms are part of an organic disease, that disease is entirely understood by all the physicians attendant.

In the first interview the therapist may take the lead in questioning. A general view of the patient's status can be made out—the age, whether married or single, whether parents are living or dead, brothers or sisters, their ages, something of the early life, home life, business life, social life, amusements, etc., may be discussed.

"The first meeting with the patient is of great importance," says Dr. Jelliffe. "Note carefully, *but avoid mentioning,* small contradictions, also observe overscrupulousness in details, attempts to be very precise and exact in small things. * * * The first hour should be wisely used to gain as much confidence as possible."

When the story of the symptoms begins, freedom of expression on the part of the patient is encouraged. The physician may wish to sit where the patient cannot see him.

Later the history may be taken up systematically.

"One may take the history systematically, guiding the patient along certain points, history of the family, etc., but it is preferable to say to the patient, 'Tell me all about yourself, and I shall listen. If I am not quite clear as to what you mean I shall ask you in detail, but tell me everything that comes to your mind.' Some patients are reticent, however, under such instructions, and may not tell anything. For such, a gradual drawing-out is necesary. One may follow any scheme, but it is often a good one to go over more or less systematically the family history, first with reference to their diseases, then with reference to the patient's relations to his family, his parents, the brothers and sisters, their ages and so forth. The early relations to teachers, nurses, governesses, tutors, and so forth, are of equal importance."

Analysis of dreams is very thoroughly made by some psychoanalysts. Dr. Jelliffe advises that some dreams which were experienced before coming for treatment be recorded, and of especial value is the first dream after beginning treatment.

With the data thus obtained as to the past life, contacts, and conflicts, the symptoms, repressions, hopes, fears, habits and subconscious nature of the individual patient, some attempt at recapitulation can be made. Analysis will proceed from here and reconstruction as may be suited to the individual case. The nature of the libido, the dangers of transference, the overcoming of conflicts, the direction of sublimation must be understood, and handled as such things vary. Only a wide acquaintance with the literature and previous directed experience are guides from this point forwards.

**5. Education, Re-Education and Explanation.**—The soundest and most lasting kind of psychotherapy is that based upon giving the patient true information about himself, the symptoms he has, the disease he has, and the diseases he thinks he has.

It is a method most difficult to use and to succeed with. It requires knowledge, insight, tact and patience on the part of the physician. A good introduction to it will be found in a volume entitled "The Psychic Treatment of Nervous Disorders," by Dr. Paul DuBois. In this book the author speaks of treating patients by "conversations"—"I cured this patient in four conversations." The book is not sufficiently well known to the general medical man in this country. Students leave medical school without even a hint of this method of therapeutics which is applicable in every patient they will treat and is the most valuable means for the treatment of one of the most populous groups of patients they will have—"Rest, drugs, diet, and psychotherapy" might well be the armamentarium of the modern Galen.

Even in definite organic disease there is often recognizable in the symptomatology the element of the patient's personality. "It is quite

as important to know what kind of a patient the disease has as what kind of a disease the patient has.'' In tuberculosis, for instance, the cure depends upon the maintenance of a long period of rest and patient continuation of a regular routine; it gets tiresome and irksome; particularly as the patient begins to feel better and stronger, he will want to get out and do something—take more than the proper allotment of exercise, go to the theatre, or fritter away his recuperative powers in a thousand ways. It is just here that psychotherapy comes in and no better example could be afforded of the best type of psychotherapy than its use in tuberculosis. The physiology of the process of recovery must be explained to the patient, the necessity for limiting his respirations, the significance of fever. Hope must be instilled into him and responsibility; in other words he must be told he can get well, but that getting well depends upon himself, and his own will power and determination to do so. Furthermore these things, to be effective, must be done not by a vague dependence upon the personality of the physician, but upon a conscious and definite plan of education and explanation.

In this form of psychotherapy—explanation and education, and the instillation of courage in patients who have definite organic disease—the practice of the profession today is generally very remiss.

Hysteria, on account of the sharply delineated character of its symptoms, is usually readily recognized as a functional psychic disease, and psychotherapy is generally employed for its amelioration. But that group of cases which can be included in the term neurasthenia or psychasthenia is not generally so recognized, largely for reasons which I have mentioned earlier in this chapter. The profession continuously tries to find an organic basis for these diseases. The mere enumeration of the commoner symptoms of this group—fatigue, insomnia, headache, dyspepsia, constipation—will call up the myriad of organic explanations which have arisen for them, and will serve to show how mechanistic the profession has become. The same symptoms may be ascribed in one quarter to ductless gland deficiency, in another to focal infection, in another to food allergy, or displaced uterus, or splanchnoptosis or intestinal autointoxication. And while it is true that sometimes we hear of a case which has long been considered functional, in which an organic basis has been found for the trouble, still the balance is usually the other way, and they are much more frequently treated for organic diseases when the cause is functional and psychic.

The psychology of neurasthenia is very little understood. The name is a bad one. We have been taught to regard these people as tired because they have done too much. As a matter of fact they have done too little, and they are tired because they have a foreign body in their

mental life—a fixed idea of fatigue. We hear a great deal about the strain of modern life; as a matter of fact, for most of the persons who are the victims of their neurosis, the conditions of life have never, since the dawn of history, been so easy. Well-to-do neurasthenics who lose their money are usually cured in the process.

But we must not make another mistake about them. A common interpretation of their nature is that they pretend to be sick from pure devilishness. This is to misjudge them. They do not really want to be sick. But they do not know how to be well. Consideration of a common experience may make us more sympathetic.*

Take the case of stage fright. You stand before an audience ready to speak but your vocal cords will not act. It is not an organic paralysis; in a few minutes you will be able to speak quite well. And it is not cussedness; heaven knows you want to speak badly enough. You cannot on account of a fear inhibition; yet what do you fear? It is not the audience; they will not hurt you. You are so filled with a fear that you will not do well that your mind cannot be filled with anything else. Furthermore most people are cured of stage fright and go on with the speech. And the process of cure is instructive. You begin hoarsely in a curiously unnatural voice to stammer out a few words. As the sounds fall upon your ears a wave of encouragement comes over you. You *can* speak after all. You begin to grope about in the vastnesses of your mind for what you were going to say; and you find some familiar ideas. You have made a beginning; you are over the first jump. More courage comes to you, and finally in the interest of your theme, the fear inhibition vanishes.

Nature abhors a vacuum in the mental world as well as the physical. A novelist of our day has described in detail of astonishing fidelity, the mechanism of the creation of a vacuum in the mental life of a modern woman—W. L. George in "The Second Blooming." It concerns a woman who in early middle life suddenly becomes conscious that she has run into a calm and that the future is empty of concern. She has married; her husband is successfully pursuing his career, and is so immersed in it that he talks of nothing else. She has borne children, will probably bear no more and they have grown to the age where they no longer need her, are more dependent upon the governess than upon her, and regard the end of the daily hour they spend with their parents with something like relief. She has her house, her income, her program. One chapter is entitled "Round and Round," and it describes a typical day during which one of her sisters takes her shopping, to lunch and to tea. The

*For this illustration I am indebted to a lecture of Dr. R. C. Cabot's which I have preserved in memory many years. Whether or not it is printed anywhere I do not know.

next chapter is called "And Round" (another selfsame day) and the next is called "And Round Again." Suddenly she beholds a sickening vista of her future, one day exactly like its predecessor, stretching interminably beyond. No one needs her any more—her children, her husband, any one. Her husband is kind to her, every one is kind to her, she has no troubles. She has nothing. Life is stripped of all meaning and robbed of all desire. She even embarks on a campaign of extravagant expenditures, for no other reason than to have something to worry about—to occupy her mind.

Now it is precisely at this state that a large number of people in modern life arrive, and a certain proportion of them having nothing else to fill in the vacuum with, begin to worry about their insides—their headaches, their stomachs, their hearts.

There is another law of the physical world that is true also of the spiritual world—that two bodies cannot occupy the same space at the same time. Neither can two ideas. If a man has an idea that his stomach is "weak," there is no use simply telling him his stomach is all right. The valuable thing is to instill into him the idea that he has a remarkably strong digestion. An idea can be replaced by another idea but not by no idea.

Of course it is recognized that the mechanism of all neurasthenic psychology is not so simple as this. It may have many ramifications, and to hunt them out is the physician's job. It is not an easy job and as we have said, the practice of psychotherapy is by no means simple. For that reason general rules for the technic of it cannot be laid down. Every case is a rule unto itself. Three general ideas can be put down, however, for guidance.

1. There are some popular misconceptions about the body, which are often ingrained in psychoneurotics, and which if dispelled will do much to bring about a normal viewpoint. They are summarized by Dr. Tom A. Williams as follows:

"Popular misconceptions about the body:

"1. Eight hours sleep is essential to health. All insomnia is dangerous and is incompatible with health. Nervous insomnia leads to insanity.

"2. Overwork leads to nervous breakdown. Fatigue accumulates from day to day and necessitates a long rest for recuperation.

"3. A carefully planned diet is essential to health, especially for the nervous person. A variety of food, eaten at the same time is harmful. Acid and milk—for example oranges and milk—are difficult to digest. Sour stomach is a sign of indigestion.

"4. Modern life is so strenuous that our nerves cannot stand the strain.

"5. Brain work is very fatiguing. It causes brain fag and exhaustion.

"6. Constipation is at the root of most physical ailments, and is caused by eating the wrong kind of food."

This list represents quite well the most frequent mistakes of neurasthenics. Particular note should be taken of what is said about insomnia, fatigue, food idiosyncrasies and brain fag—for they are very common causes of symptoms.

Insomnia may continue for years while the patient's weight remains stationary, the appetite is good, the brain is efficient. People are astonished when you point this out to them. "Isn't it bad for the health to lie awake?" "Apparently not; take yourself: you look well, your blood, urine, weight, color, nervous system are all normal. What harm has it done? Not nearly so much as the taking of hypnotics would."

Fatigue is the normal result of exertion. When exertion is real (not fancied) the body quickly recuperates from it. The physician of all men knows this. It is a common experience for him to be on the go for days and nights together—to have physical work, mental work, responsibility and worry. Yet when it is lifted and he gets one night's sleep, he awakes as completely refreshed as if he had been in bed for the whole night through every night for a week. In fact often more so, because he has earned his recuperation. It depends upon having a healthy nervous system. But the neurotic is tired because he is obsessed with fatigue, because he expects to be tired, because he doesn't know the physiology of fatigue and has made up his mind that the work he does results in chrònic strain. It is a familiar experience with those who treat people who have a certain stint of work to do—school teachers for instance—that some of them, seeing a long stretch of labor ahead, decide that they will be very tired, and *sct* themselves to be tired about the end of the school term. In a healthy life and nervous system the wells of recuperation fill every day for the work of that day. William James' wise and famous essay on "The Energies of Men" deals with a phase of this subject. He points out that a man undertaking a long and arduous task will get to a place very early when it seems more than he is able to do; yet as he goes on he finds that quite unconsciously he is performing it smoothly and without fatigue, as a runner runs after he gets his second wind. He has, without knowing how, tapped deeper and deeper wells of reserve strength.

Food phobias are the cause of much of the complaint of dyspeptics. They must be reeducated by actual demonstration of the abilities of their own digestions. They gain confidence in themselves by eating the very things they feared.

The idea that brain work is very fatiguing is exactly the opposite of the truth. It is very stimulating. To prepare a scientific essay for one's county society, to deliver a speech, to write a book—these fill one with new ideas, enthusiasms, confidences. The mind is not a full bucket from which one dips a cup and by so much exhausts the supply; it is a dynamo which by its own working, stores energy for future use.

2. The second suggestion is a hint for prudence. Begin on the psychoneurotic gradually. He or usually she has long been under the impulsion of his or her neurosis. To say abruptly that there is nothing the matter with the stomach or that the fatigue is imaginary is to cause her to believe you are unsympathetic and to alienate her cooperation.

For your own guidance, the preliminary examination should be very thorough. This not only eliminates the possibility of overlooking an organic disease, but also gains the patient's confidence. They are readier to believe you when you tell them their digestion, nervous system, urine and blood are normal.

3. Supplant one idea with another (positive) idea, not simply with a negation such as, "There is nothing the matter with you." Instill a pride in how healthy they are, how much endurance they have, to take the place of how sick and weak they were. "The essence of psychotherapy and education," writes Dr. Tom A. Williams, "is to associate useful activities with agreeable feeling-tones and to dissociate from injurious acts the agreeable feeling-tones that may have been acquired."

It was a healthy thing about the philosophy of Theodore Roosevelt, as contrasted for instance with the philosophy of the young men of the Byronic age or of the eighteen-nineties, that he made people proud of how strong they were, how much endurance they had, rather than how weak they were, how much fun it was to work rather than how agreeable to loaf.

## References

DuBois, Paul: The Psychic Treatment of Nervous Disorders. Translated by Smith Ely, Jelliffe and William A. White. Funk & Wagnalls Co.

Frink, H. W.: Morbid Fears and Compulsions, Moffat, Yard & Co. 1921.

Jackson and Salisbury: "Outwitting our Nerves." Little, Brown & Co.

Jelliffe, Smith Ely: The Technique of Psychoanalysis—Nervous and Mental Monograph Series No. 26.

Jung: Psychology of the Unconscious, Translated by B. M. Hinkle.

Meyer: An Attempt at Analysis of the Neurotic Constitution. Am. Jour. Psychology, 1903, xiv.

Putnam, Burrow and White: "Symposium on the Theories of Freud, Jung, and Adler," Jour. Abnormal Psychology, August, 1917, xii, No. 3.

White, William A.: Mechanisms of Character Formation. An Introduction to Psychoanalysis, Macmillan & Co.

## CHAPTER XIII

## MISCELLANEOUS PROCEDURES

There are a number of methods of treatment which cannot be classified under any of the headings heretofore used in this book. Most of them are semisurgical in character, but it behooves the modern internist to acquire a smooth technic for the performance of blood transfusion, lumbar puncture, thoracentesis, etc.

### I. BLOOD TRANSFUSION

Blood transfusion is the transference of whole human blood from the blood stream of a healthy person to the blood stream of a patient. The blood is usually removed from the vein of the arm of one individual, known as the donor, and injected into the vein of the arm of the patient, known as the recipient. The operation has been done from the days of the middle age, but only during the last quarter century has the technic become perfected. In earlier times the blood of an animal was injected into man, but it has been found that while morphologically the blood of one species may resemble another, there is always a biologic difference between the blood of one species and the blood of a different species. The serum of one species of animal will either cause agglutination (clumping) of the corpuscles of the other species or it will cause hemolysis (dissolving) of the corpuscles of the other. Therefore it is necessary in human therapeutics to use only human donors. Even thus it has been found that there are certain groups of persons whose blood is not compatible with others and will cause agglutination or hemolysis. Therefore it becomes necessary to make tests of the blood of the donor and the blood of the recipient to see that they are compatible.

In reviewing blood transfusion we will consider first the indications for it, second the manner of determining the compatibility of the donor's with the recipient's blood and third the technic of the transfusion itself.

**Indications.**—(1) *Severe traumatic hemorrhage*, from gunshot wounds, or injuries with amputations, etc.

(2) *Secondary anemia* from hemorrhage, hemorrhage from duodenal or gastric ulcer, typhoid ulcer, tuberculous lung, etc. In ruptured ectopic pregnancy it can be used to prepare the patient for operation.

These first two are certainly the most important indications for transfusion. It often saves lives in those conditions.

(3) *Pernicious Anemia.*—It seems to terminate and abort remissions. In aplastic anemia it seems not to be of any value.

(4) *Hemorrhage Diathesis.*—In purpura hemorrhagica, by supplying platelets it is specific. In hemophilia it works in a somewhat similar manner. In hemorrhagic disease of the newborn there are some technical difficulties, (such as the size of the infant's vein) which make transfusion, under ordinary conditions, impractical, but intramuscular injections into the infant's biceps of 5 c.c. of whole blood from a parent are usually effective.

(5) In miscellaneous conditions called by Lindeman, *critical periods of disease*—such as sepsis, pneumonias going bad, nephritis with impending uremia, shock, poisoning, etc.

(6) *Leukemias* are not benefited.

**Testing the Blood of Donor and Recipient.**—Landsteiner first pointed out that the phenomenon of agglutination of human corpuscles by human serum was not pathologic but a biologic character. Classifying many different individuals he divided them into three groups. Later Jansky and Moss, working independently, described four groups. Jansky's Groups I and IV are just the reverse of Moss's. Jansky deserves priority of publication, but Moss's grouping has become generally used and standardized and is the grouping described here. It has been found that the question of hemolysis is of no importance and the groupings are made on the basis of agglutination alone.

Moss Classification.—

*Group I.*—The serum of these individuals will not agglutinate the cells of Group II, Group III, or IV. The cells of Group I are agglutinated by the serums of all other groups.

*Group II.*—The serum agglutinates cells of Groups I, and III. The cells are agglutinated by serum of Groups III and IV.

*Group III.*—The serum agglutinates cells of Groups I and II. The cells are agglutinated by the serum of Groups II and IV.

*Group IV.*—The serum agglutinates the cells of all other groups. The cells are not agglutinated by any other group.

Incidence of the four groups in Man.

| | |
|---|---|
| Group I. | 10% |
| II. | 40% |
| III. | 7% |
| IV. | 43% |

**Method of Testing Donor's and Recipient's Blood for Agglutination.**—*Macroscopic Method:* (requires 24 hours).—Set up four test tubes. In two of the tubes put 2 c.c. of normal salt solution. Make a venepuncture and obtain 5 c.c. of blood from both donor and recipient. Put 1 c.c. of blood of the donor in the salt solution and 4 c.c. of blood of the donor in a clean test tube. Do the same with the blood of the recipient. Allow the 4 c.c. whole blood tubes to stand and coagulate. Centrifuge the blood and salt solution tubes. You have now washed corpuscles and serum from both donor and recipient. Set up two more tubes. In one put 9 drops of the donor's serum; add 3 drops of the washed corpuscle suspension of the recipient. In the second tube put 9 drops of the recipient's serum and add 3 drops of the washed corpuscle suspension of the donor. Both tubes are incubated at 37.5° C. for two hours and placed in the ice box overnight. If no agglutination occurs in either tube the transfusion can be made. This is the most reliable test method. The only objection to it is that it is time consuming.

*Brem Method Microscopic.*—This may be done within an hour.

Apparatus required:

Set up 3 clean test tubes.
Set up 3 test tubes with 1 c.c. of 2 per cent sodium citrate.
4 ground glass hanging slides with cover slips.
1 platinum loop.

It is necessary to have individuals who are known members of Groups II and III. These individuals can be found among attendants in any laboratory or hospital and be always on hand. From the individual to be tested, blood is withdrawn by venepuncture and 2 or 3 c.c. are put in a clean test tube and allowed to clot, while a few drops are put in a test tube containing 1 c.c. of a 2 per cent solution of sodium citrate. The blood from the known Group II and III individuals is tested the same way.

When the serum has separated in all the whole blood tubes, arrange the hanging drop slides as follows:

Slide I. 2 loopfuls of serum of Group II and 1 loopful of unknown corpuscles.

Slide II. 2 loopfuls of serum of Group III and 1 loopful of unknown corpuscles.

Slide III. 2 loopfuls of unknown serum and 1 loopful of corpuscles of Group II.

Slide IV. 2 loopfuls of unknown serum and 1 loopful of corpuscles of Group III.


Fig. 38.—Blood groups. Graphic representation of agglutinations (after Sanford).

Agglutination will begin immediately as seen under the microscope and readings can be made at the end of half an hour.

The grouping of the unknown can be determined by reference to Fig. 38.

The same technic can be employed when there is not at hand donors of known groups by testing a loopful of the donor's corpuscles and a loopful of the recipient's serum.

The danger in transfusion lies solely from the action of the recipient's serum on the donor's corpuscles. Group I patients then may have donors of any group. Group II patients must have Group II or Group IV donors. Group III recipients must have Group III or Group IV donors. Group IV recipients must have only Group IV donors.

Besides the compatibility test a Wassermann should always be done upon the donor, to be sure he is negative.

**Technic.**—Two general methods have come into use. One is to transfer whole blood from the donor to the recipient before it coagulates. The other is to use a noncoagulating substance (sodium citrate) and mix it with the donor's blood, injecting it by gravity into the recipient. Under the first heading come the various machines, such as the Unger machine, which connect up directly the recipient's and donor's veins, (2) the paraffin lined tubes such as the Percy and Kimpton-Brown tubes and (3) the syringe-cannula method of Lindeman. I shall confine myself to the technic of the last.

**Lindeman Method.**—The method consists in placing a needle or cannula in the median basilic vein of both donor and recipient, and one operator removing 10 c.c. of blood in a glass syringe from the recipient and the other operator injecting it into the donor as rapidly as possible.

1. The arrangement of the operating room is important. Attention is called to the diagram (Fig. 39). The donor and recipient lie on tables about four feet apart; the donor's head is to the recipient's feet. Between them is a table with three basins of sterile normal salt solution. A nurse presides over this table. The operators and the nurse should be perfectly familiar with the procedure and trained to work in unison and quite rapidly.

2. At least ten 10 c.c. glass or Record syringes are necessary. They must, of course, be sterile.

3. Lindeman has devised a special cannula to be used. It is not ideal as it is often difficult to get it into a vein without cutting down on the vein. Ordinary needles of large lumen, can be used quite as well.

4. The procedure: The needles are placed in the veins. The first operator withdraws 10 c.c. of blood from the donor. He puts the filled

syringe on the table between the operators. The second operator picks it up and injects it into the recipient's vein. When it is emptied he hands it to the nurse who washes it out in the three basins of salt solution and puts it ready for the first operator to use again when its turn comes. In the meantime the first operator has filled a second syringe and the procedure is repeated over and over. As much as 1500 c.c. can be given.

Various apparatus have been devised and are on the market to be used in direct blood transfusion. They all depend upon the same general

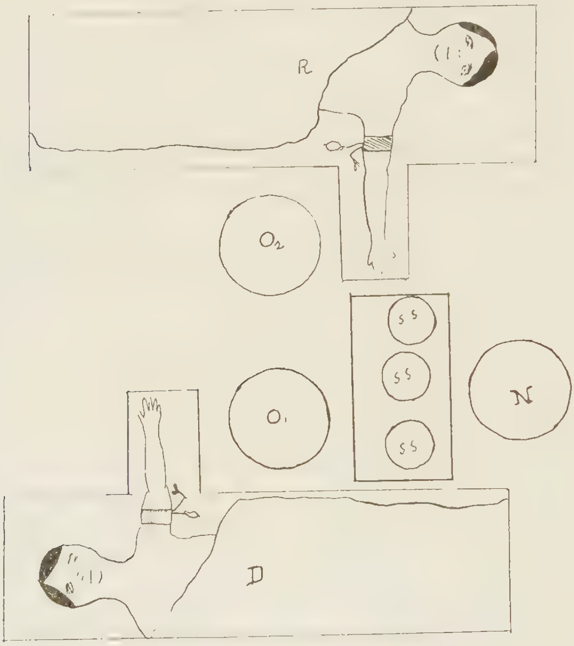



Fig. 39.—Plan of operating room for blood transfusion by Lindeman method.

*D*, donor; *R*, recipient; *O1* and *O2*, operators 1 and 2; *N*, nurse to rinse syringes; *SS*, 3 basins with salt solution.

Operator *1* removes a syringe full of blood from donor's arm and hands syringe to operator *2*, who injects it into recipient. Operator *2* then places syringe on table where nurse rinses it in three washings of salt solution and places it ready for operator *1* to use when he is ready.

principle—to unite the veins of donor and recipient by a continuous connecting tube with needles in the respective veins and broken in the middle by a syringe fitted with a two- or three-way stopcock so that merely pulling the syringe in and out and changing the positions of the stopcocks will deviate the flow of blood as wished. No special directions for these apparatus are needed as when purchased they are furnished for each one by the manufacturers.

**Sodium Citrate Method—Lewisohn's Method.**—The blood is prevented from coagulating by keeping it in 2 per cent sodium citrate.

"The blood is received in a sterile graduated glass jar containing 20 c.c. of a 2 per cent sterile solution of sodium citrate at the bottom. While the blood is running it is well mixed with the citrate solution by means of a glass rod. The flow of the blood should be in a steady, continuous stream and when there occurs slowing of the stream, as is often observed with a sudden drop in venous pressure, due either to syncope or too snugly applied tourniquet, the needle should be immediately withdrawn and a clean one inserted. If the blood is allowed to flow in an impeded stream, there will be clotting of the whole or part of the blood collected because of the incipient coagulative changes which have taken place in transit from the vessel to the citrate solution. After the blood has reached the 250 c.c. mark another 30 c.c. of the citrate solution is added and the blood is permitted to flow until there are 500 c.c. of the mixture. If more blood is desired, a sufficient amount of citrate solution is added to maintain this ratio of 0.24 per cent. The blood may be carried to the recipient's room or the recipient may be brought into the operating room. The needle is then introduced into the recipient's vein, after the manner above described, and attached by rubber tubing to a glass irrigating flask, the tubing and the bottom of the flask having been previously filled with saline solution. The citrated blood is then transferred into the flask and permitted to flow into the vein of the recipient. It is advisable to have the blood run slowly in order to guard against suddenly overloading the right side of the heart, and in order to watch for any untoward effects upon the patient.

"One of the chief advantages of this method is that since the danger of coagulation has been removed there is no necessity for haste in the operation. It is usually not necessary to cut down on the donor's or patient's veins in order to withdraw or introduce the blood.

"In concluding I would again state that when transfusion is indicated, no matter what operative procedure is the method of choice, the chief point of consideration is the selection of a donor, who, above all else, must be of the group whose corpuscles are compatible with the recipient's serum." (Sanford.)

**Comparison of the Two Methods.**—The advocates of the Lindeman method say that they get no reactions after transfusion such as follow the citrate method, and that more blood can be transfused at one time. On the other hand, the technical advantages of the citrate method are considerable: the blood can be obtained and prepared carefully; the

preparation can be observed to see that there are no clots in it, and can be given slowly and carefully. The citrate does usually cause a reaction —a chill and slight shock. Unger has recently expressed his belief that the presence of citrate so modifies the blood that it is unfit to be injected into a patient, and that the citrate method should be abandoned. Without necessarily going that far we may say that the choice of method should be carefully made by the physician, and circumstances will determine him to employ one of the above technics.

## II. VENESECTION

Venesection is one of the oldest of therapeutic practices. It had its greatest vogue probably during the 17th and 18th centuries. Von Helmont cried that "a bloody Moloch presides in the chairs of medicine," and bleeding at that time was quite as fashionable as the pulling of teeth is today.

It may still be done in pneumonia, impending or existing uremia, hypertension, and premonitory signs of cerebral apoplexy.

The technic consists of putting a tourniquet on the arm and entering a vein with a large sized needle, and allowing the blood to flow. The tourniquet should not be so tight as to constrict the arteries; if this cannot be determined exactly and the flow is slow, the tourniquet should be released and again tightened. This allows blood to flow into the arm and once more fill the veins. A blood pressure cuff with bulb, the dial tube being clamped off, makes an excellent tourniquet for this purpose, because the pressure can be raised or released without moving the arm or disturbing the tourniquet.

## III. LUMBAR PUNCTURE

Lumbar puncture or rachiocentesis is the withdrawal of cerebrospinal fluid, by the insertion of a cannula, through an intervertebral foramen, into the spinal meninges, at the lumbar level.

In order fully to appreciate the points in the technic of lumbar puncture, it is necessary to know something of the physiology of the cerebrospinal fluid. This fluid fills the entire space between the cord and brain and the dura mater; and it fills the ventricles of the brain. Physically and chemically it is unlike any other fluid in the body, except the aqueous humour of the eye, with which there is almost complete similarity. While it differs widely from the blood serum, it is probably secreted from the blood serum by selective action of the ependyma cells of the chorioid plexus, or, as Mott has called it, in order to emphasize

the fact that cerebrospinal fluid is a secretion and not a transudate, the chorioid gland. There are possibly other sources of the fluid than the chorioid. Dandy and Blackfan report a case of hydrocephalus in which there was a complete obstruction of the foramina of the ventricles, so that, the chorioid plexus lying in the ventricles, the source of supply of cerebrospinal fluid was cut off from the spinal axis; but upon lumbar puncture, 5 c.c. of fluid was obtained and was quickly replaced. In such a case it is probable that the cerebrospinal fluid was formed, as lymph is in the perivascular spaces, by exudation from the vessels.

The question as to whether the fluid circulates has given rise to considerable debate in the past, but there is now a general consensus of opinion that it does circulate, though somewhat irregularly and sluggishly. Dandy has shown in a series of studies of hydrocephalus that: occlusion of the aqueduct of Sylvius causes hydrocephalus localized in the third and both lateral ventricles, of the foramen of Monro causes unilateral hydrocephalus and of the foramen of Magendie causes hydrocephalus of the fourth ventricle. He has shown that the cerebrospinal fluid originates at the chorioid plexus, escapes through the aqueducts of Sylvius and Monro and the foramina of Luschka and Magendie, and is absorbed in the subarachnoid space. There is continuous slow circulation of the cerebrospinal fluid in health. A particularly important thing to remember is that to most substances, deleterious to the cerebrospinal axis, the chorioid plexus is completely impermeable. Flexner, for instance, was unable to pass neutralizing antibodies for poliomyelitis virus into the spinal fluid by giving them intravenously; but when he first caused an aseptic inflammation of the plexus by injecting horse serum intraspinally the antibodies passed through readily when given intravenously.

In health we must assume that many substances (bacterial, immunizing, and chemical) do not pass from the blood stream into the cerebrospinal fluid, but when the chorioid plexus has been irritated by some foreign substance in the spinal canal, or by a generalized infection, some permeability does occur.

The total amount of cerebrospinal fluid under conditions of health is estimated variously as between 60 c.c. and 150 c.c. The pressure of the fluid is probably not constant, but may be set down as about 6½ to 12 mm. of mercury and 90 to 150 mm. of water. Quincke gives children's readings as one-third less than adults. The highest pressures, under pathologic conditions, are found in brain tumors.

The main functions of the cerebrospinal fluid are probably mechanical; it gives support to the central nervous symtem, protects it from jars, and sudden changes of temperature. Whether or not it has any other

functions is largely a matter of argument. Kafka and Golman believe that, by reason of the chorioid filter, it protects the nervous system from infections and poisons. Frazier records this experiment in point; he injected 1 c.c. of a 1 per cent solution of trypan blue into the jugular vein of a rabbit with no disturbance of the nervous system; but the injection of 2 c.c. of 1 per cent solution into the subarachnoid space was fatal in 12 hours.

Normal spinal fluid is a beautiful clear liquid, sparkling like the purest spring water. It normally contains from 2 to 10 lymphocytes per c.mm. These cannot, of course, be seen grossly. The most marked gross change in it is found in cerebrospinal meningitis—and other pyogenic types of meningeal infection. In these the fluid is milky with pus. The diagnostic tests upon the fluid and their significance do not come within the scope of this book.

**The Technic of Lumbar Puncture.—**

1. Apparatus:

a. A lumbar puncture needle, preferably of a type such as Strauss and, independently, Wolfsohn designed with a three-way stopcock so that the stream can be regulated. The needle should be of 17 or 18 gauge, of nickeloid or nonbrittle steel, and 10 to 12 cm. in length.

b. Syringe and novocaine for local anesthesia.

c. Sterile test tubes to collect the fluid.

d. Iodine and swabs.

e. A pressure gauge.

f. Connecting rubber tubing and gravity funnel (a 30 c.c. Luer syringe barrel is quite sufficient) if any intraspinal therapy is to be done.

2. The patient: General anesthesia is not necessary, but may sometimes be desirable. The patient should have had a cathartic the night before and have had no meal for six hours.

*Posture.*—It may be done with the patient sitting up or lying on the side.

*Landmarks.*—A streak of iodine should be made down the spinous processes of the vertebrae, and another bisecting it at the level of the crest of the ilia (Fig. 40). The point of bisection marks the point of election for insertion of the needle—just below the 4th lumbar spinous process.

3. Procedure: All apparatus and material used must be sterile, and the operator must prepare his hands as for a surgical operation.

The spot selected is between the third and fourth or between the fourth and fifth lumbar vertebrae.

Lusk as a result of the dissection of a number of bodies has stated that "the only vertebral interspaces through which puncture of the subarachnoid space can be made with practical assurance that nerve struc-

tures will not be penetrated are the fourth lumbar and lumbosacral, preferably the former.'' The conus medullaris, he states, sometimes comes as far down as the second and third lumbar level. However, puncture is often made at the third and even second spaces without causing any untoward symptoms. Few cases of paralysis have been recorded from simple lumbar puncture.

Fig. 40.—Lumbar puncture. Step one. Patient with markings along spinous processes of vertebrae and from crest of one ilium to the crest of the other. The intersection of these lines marks the spinous process of the fourth lumbar vertebra.

This site is infiltrated with 1 per cent novocaine solution (Fig. 41). The skin is first infiltrated and then the needle is thrust through the tissues and these are infiltrated.

The lumbar puncture needle with the stylet in place is thrust through the skin midway between the upper and lower spinous processes, perpendicular to the skin, and parallel to the operating table. When the bony structures are approached there will be an increased sense of re-

sistance communicated to the operator's hand. A slight give to the needle marks the entrance of the spinal membranes. If the needle is felt to go up against bony substance, it may be withdrawn slightly and a new direction given to it. Students should not hesitate to try lumbar puncture for fear of its difficulties; the operator may do it as well the first time as he does the thousandth.

Fig. 41.—Lumbar puncture. Step two. Infiltration of skin with novocain, 1 per cent, for anesthesia.

Fig. 42.—Lumbar puncture. Step three. The needle has been introduced, the stylet withdrawn and the spinal fluid is being collected.

The needle traverses the following structures in its excursion: skin, subcutaneous tissue, intraspinal ligament, subflavous ligament, epidural fat, vein plexus, dura mater, arachnoid. In this region the dura and arachnoid are in contact while the pia invests the cord and nerve-roots. The dural sac is between the arachnoid and the pia mater.

When the membranes have been entered, the stylet is withdrawn and the fluid allowed to flow. If no fluid flows, it is considered that the canal was not entered. The stylet is reinserted, the needle partially

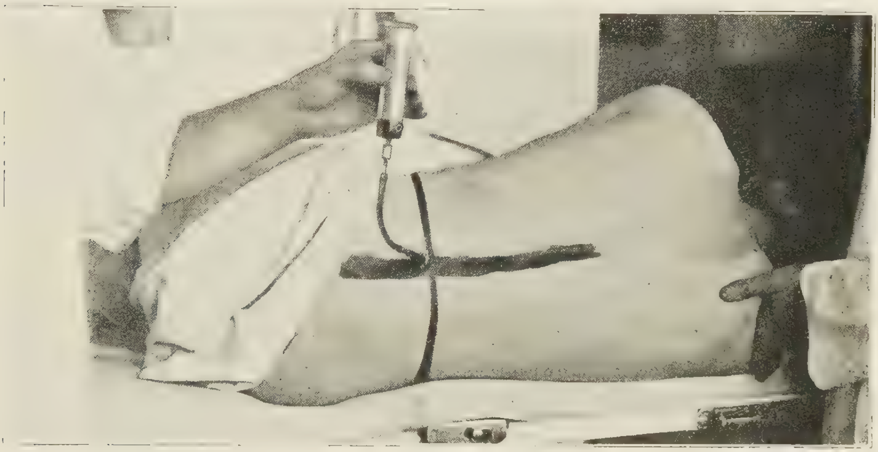


Fig. 43.—Intraspinous administration of drug or serum by gravity, after removal of spinal fluid.

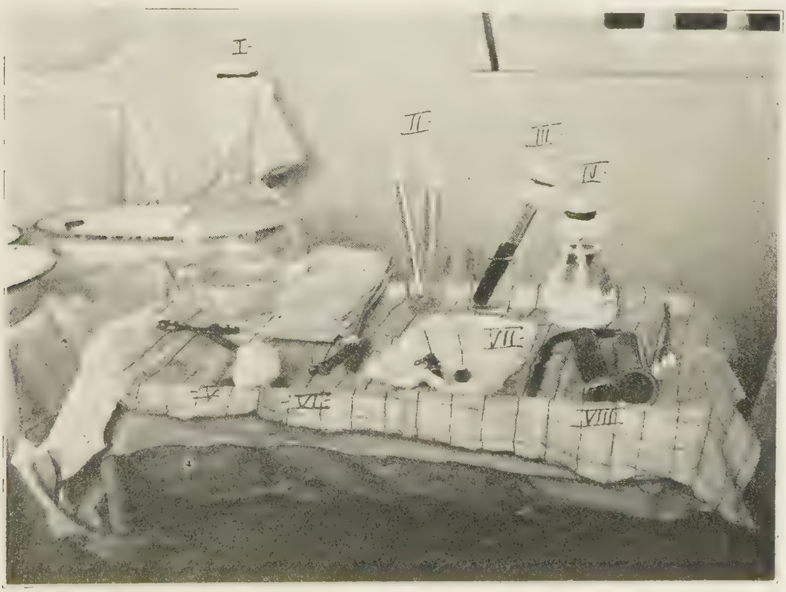



Fig. 44.—Apparatus and setup for spinal puncture and intraspinous administration of salvarsanized serum.

*1*, Sterile salt solution; *2*, sterile empty test tubes for collection of spinal fluid; *3* serum removed from patient on previous day. It has been inactivated, is kept warm in warm water; *4*, novocain solution; *5*, swab for iodine; *6*, hypodermic syringe for local anesthesia; *7*, spinal puncture needle; *8*, 30 c.c. syringe and tubing for serum.

withdrawn and a new thrust made. Sometimes blood drips out from puncture of the vein plexus outside the dura mater.

When the fluid begins to flow, it is collected in a test tube for examination or whatever purpose the physician has in mind.

If it is desired to introduce some fluid in the canal—i.e., antimeningococcic serum, or salvarsanized serum, the proper amount of spinal fluid

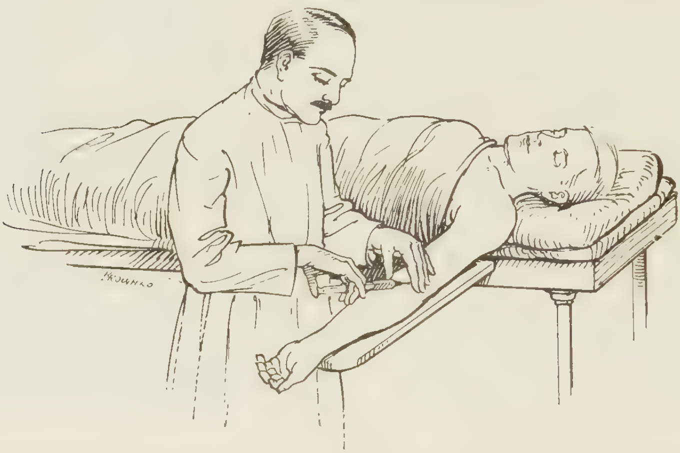


Fig. 45.—Technic of Swift-Ellis method of introducing salvarsanized serum intraspinally for cerebrospinal syphilis.
Step one. Intravenous administration of 0.6 gm. arsphenamine in vein of left arm.

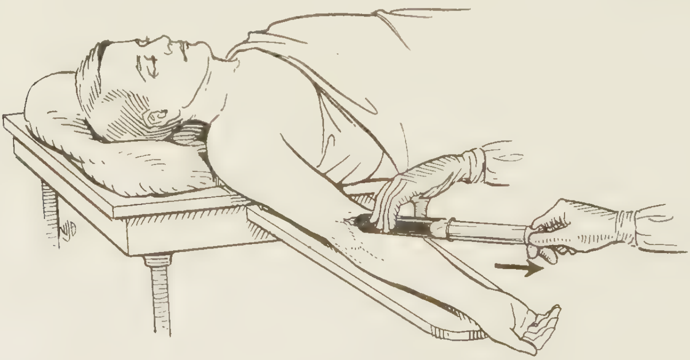


Fig. 46.—Swift-Ellis procedure, step two. Thirty minutes later withdrawing 60 c.c. of blood from right arm.

is withdrawn (usually not more than 30 c.c.), the funnel of the gravity apparatus filled with the fluid is connected by rubber tubing with the end of the needle and the fluid allowed to flow in. It should not have any other force than gravity (Fig. 43).

**After-Treatment.**—Simple lumbar puncture will, nearly always, result in a headache. It is not, in my opinion, advisable to do a lumbar punc-

ture in the physician's office, and allow the patient to get up and go home. The patient should be kept in bed, *with the foot of the bed elevated* for at least twelve hours.

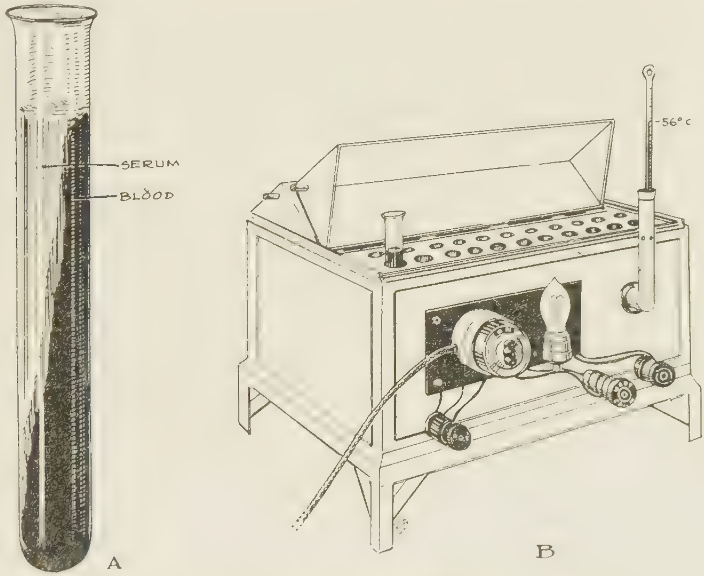



Fig. 47.—Swift-Ellis procedure, step three. *A*, separation of the serum; *B*, inactivation of serum at 56° C. for one hour.

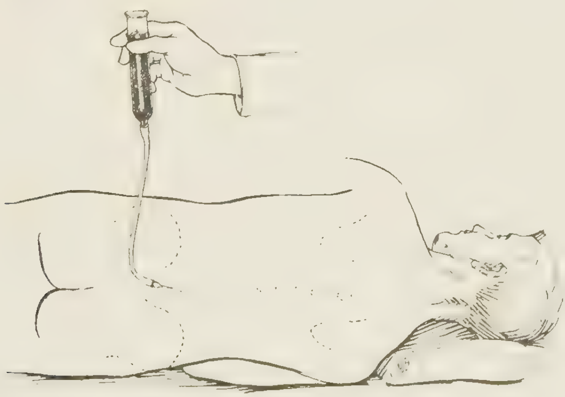


Fig. 48.—Swift-Ellis procedure, step four. Intraspinal introduction of 30 c.c. inactivated salvarsanized serum, by gravity after withdrawal of 30 c.c. spinal fluid.

The after-treatment of the administration of serum intraspinally is one of the most important parts of the treatment. The patient should have the foot of the bed elevated, and be kept in one position for three hours. Morphine gr. 1/8 to 1/4, or codeine gr. 1/2 should be begun immediately and kept up continuously every three or four hours as needed

to keep the patient comfortable. Headache and some fever may be expected.

The elevation of the foot of the bed is designed to equalize the pressure due to loss of fluid, which is probably the cause of headache. In some cases the lumbar puncture needle being large leaves a rent in the dura through which fluid escapes, keeping up the headache. For this reason, in selected cases, a needle of small gauge (19 Luer) is recommended.

**Indications for Lumbar Puncture.—**

Without introduction of serum or drug:
- Nonspecific meningitis for drainage.
- Hydrocephalus.
- Uremia.
- Impending cerebral apoplexy.
- Convulsions.
- Mental symptoms in infectious diseases—mumps, scarlet fever.

For diagnostic purposes:
- Before discharging a syphilis patient.
- Cerebrospinal syphilis.
- Meningitis.
- Lethargic encephalitis.
- Skull fracture.

With introduction of serum or drug:
- Cerebrospinal syphilis.
- Epidemic cerebrospinal meningitis.

**Contraindications.**—Cases of sudden death following lumbar puncture have occurred, in almost every instance, in patients with cerebral or cerebellar tumors.

## IV. TECHNICAL PROCEDURES USED IN DISEASES OF THE CHEST

### A. Thoracentesis

Thoracentesis is the name applied to the aspiration of fluid from the pleural cavity. In performing this operation a hollow needle or cannula is inserted between the ribs, through the skin, intercostal muscles, intercostal fascia, and pleura and the fluid either aspirated by suction or allowed to flow out by siphonage through a rubber tube. A general anesthetic is not necessary and the procedure causes little inconvenience to the patient.

**Indications.**—*Pleural effusion and hydrothorax* are the conditions for which it is usually done. It may be done in certain cases of empyema or of infective pleural effusions following pneumonia and influenzal bronchopneumonia, in order to improve the patient's condition, pending thoracotomy and drainage.

**Technic.**—*The needle:* Whatever method (Potain aspiration or siphonage) is used to withdraw the fluid, the needle may be the same. A sharp hollow needle, without stylet, is often used. But when possible a needle of a different type (with a blunt end) is preferable, because, as the fluid is removed, the lung expands and may come up against the sharp point of the needle, causing bleeding or worse, pneumothorax (this is, however, an accident which is more warned against than occurring).

The needle which I have found most satisfactory is the one devised by Frederick T. Lord of Boston. In the photograph of it below (Fig. 49), it will be noticed that the cannula is blunt and it is fitted with two stylets, one sharp and the other blunt. The sharp stylet is used to puncture the intercostal wall and pleura, and when the pleura is entered it is fully withdrawn, and the apparatus still remains airtight. The stopcock is turned and the fluid is allowed to begin to flow out. While it is flowing, the sharp stylet may be replaced by the blunt one: now if the flow stops and it is desired to explore to see whether there is a clot of fibrin or whatever in the cannula the blunt needle can be thrust in without danger of injuring the lung. My only objection to the Lord needle and imitations of it, as usually put up in an aspiration set and sold in supply houses, is that its caliber is too large. I have accordingly had Sharp and Smith of Chicago make one for me of gauge 6 French catheter. This is much more satisfactory.

**Apparatus.**—Aspiration by the Potain method and with the Potain aspirator is the most frequently performed procedure. A rubber tubing connects the needle with a bottle. In this bottle is fitted a two way cock, one opening of which connects by another tubing with a pump which will create a vacuum in the bottle, the other opening connected by the needle with the pleura allows the fluid to flow into the bottle. When the pleura has been entered the bottle is emptied of air, and the cock connecting with the patient is opened. The fluid is thus aspirated into the bottle.

In the siphonage method the rubber tube leading from the cannula is filled with water before being connected. The other end is inserted in a basin of water. The column of water is kept in the tubing by keeping the stopcock in the trocar opening closed. When the pleura is entered

this stopcock is opened and the water flows into the basin causing enough suction to overcome any negative pressure which might be present in the thoracic cavity.

**The Procedure.**—The patient is usually sitting up. The site of entry is selected, painted with iodine, and anesthetized with a local anesthetic.

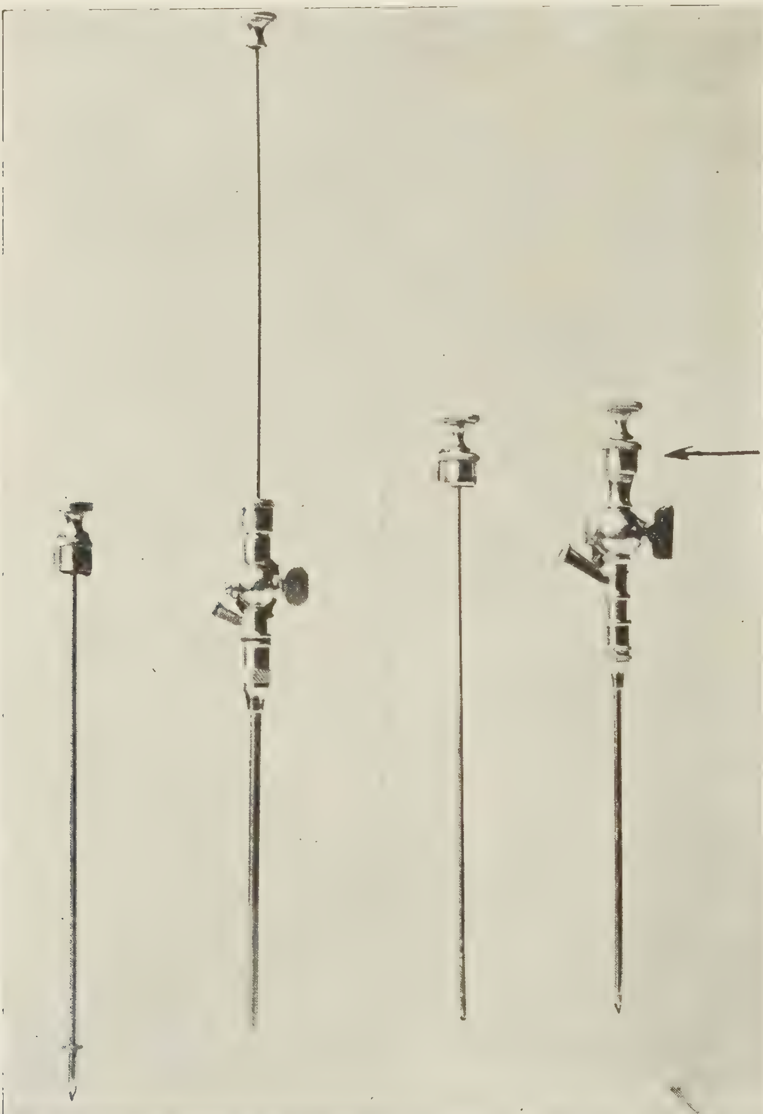


Fig. 49.—Thoracentesis needle of Lord. Two stylets: one sharp, and one blunt. After the sharp one has been inserted in parietal pleura, it is withdrawn and the cuff (indicated by arrow) unscrewed. The blunt stylet is then inserted and may be used to clear the cannula if obstructed by clot, etc., without danger of tearing or scratching the lung. There are two sizes, the smaller one to the right made for me by Sharp & Smith, Chicago, Ill.

The skin should be infiltrated first, and the needle thrust through to the pleura and this well anesthetized.

The skin over this region is tough and thick and it is better, before inserting the needle, to cut a small slit in the skin with a little cataract knife.

The needle is now thrust into the pleura, the connections made, the stylet withdrawn and the pleura emptied.

The amount to be withdrawn varies. I have withdrawn a very massive effusion of long standing amounting to 3000 c.c. When the pleura

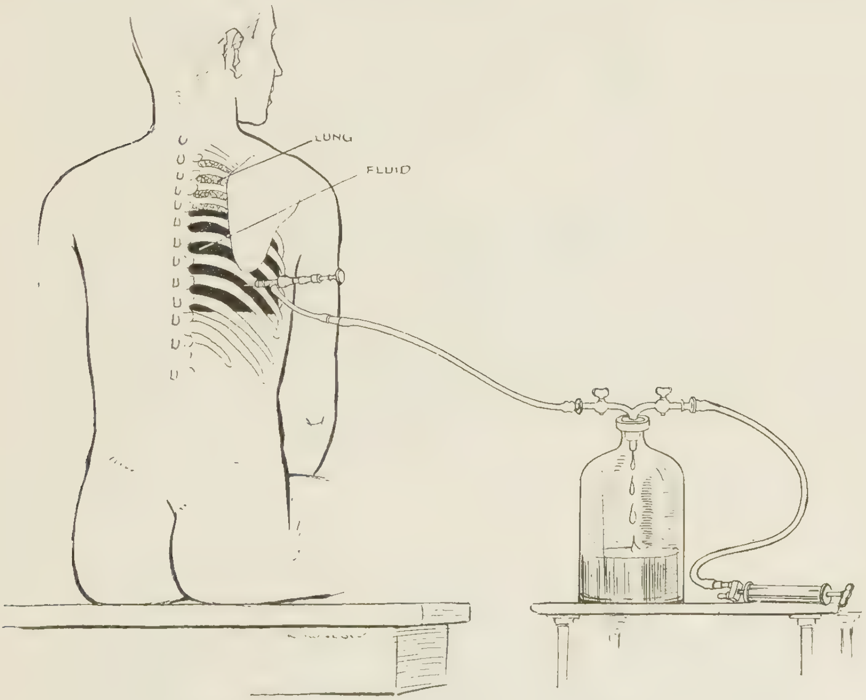



Fig. 50.—Thoracentesis with Potain apparatus.

is emptying the lung may be felt, gently bounding against the needle: there is no other word which exactly fits it but bounding; the operator feels a gentle tap against the needle, lasting only for a moment. One other indication of the time to withdraw the needle is coughing, which may be severe and uncontrollable on the part of the patient.

Complications and sequelae may occur. Pneumothorax is a possibility from puncture of the lung. Subcutaneous emphysema may occur at the point of puncture: pneumothorax need not necessarily accompany this. Fainting, nausea and vomiting are not infrequent. Capps and Lewis have pointed out the possibility of pleural shock: they were able

to produce it in dogs following irrigation of the pleura. Sudden death may occur during pleural shock. Edema of the lungs has occurred: there may be slight degrees of it with copious frothy albuminous sputum, and it may be fatal.

All of the accidents are rare, except the fainting, nausea and vomiting. In my experience of over 800 tappings, none of them has occurred.

### B. Artificial Pneumothorax

Artificial pneumothorax, the production of a collapse of one entire lung, by the introduction of gas into the pleural cavity was first used by Forlanini in 1882. It had been suggested by Carson, an English physiologist, early in the nineteenth century, and as a matter of fact even before that. Baglivi recorded the fact that two patients with pulmonary tuberculosis had been improved by pneumothorax produced by gunshot wounds.

In 1898, Murphy advocated its use and his description of the method was followed by a furore. It fell, however, into disrepute and it was not until ten years later that it was repopularized, partly by the introduction of suitable apparatus and, partly, by the splendid results reported for it in advanced pulmonary tuberculosis.

**Technic.**—*Apparatus.*—There are several styles of apparatus available. The Robinson and Floyd is probably the most used in this country, and is the one we have usually used in our work. It has, however, many faults. The manometer is too short, and often a cough from the patient will blow out its entire contents. The bottles are too large to sterilize easily. But the greatest fault, and the one common to nearly all types of apparatus, is that the air is displaced by the siphonage of water from one bottle to another. A much better way is to let it drop from one receptacle to the other as in the apparatus in Fig. 51.

The essential features of an apparatus are two vessels, connected by tubing, a double outlet for one, and a manometer connection. Fluid, usually water, flows from one into the other displacing air or other gas, which flows out into the pleura. It must flow evenly, slowly and gently. Therefore the second vessel must have a cork, with double perforations, one to allow the water to flow in and one to allow the air to flow out.

*The Needle* is a very essential part of the apparatus. The Floyd-Robinson needle is perfectly satisfactory in all respects. It is sufficiently pictured in Fig. 52.

*The Procedure.*—Novocaine is always used, care being taken to infiltrate the pleura. It is well to have a small cataract knife to make an opening in the skin, as the needle goes in much more smoothly, the skin

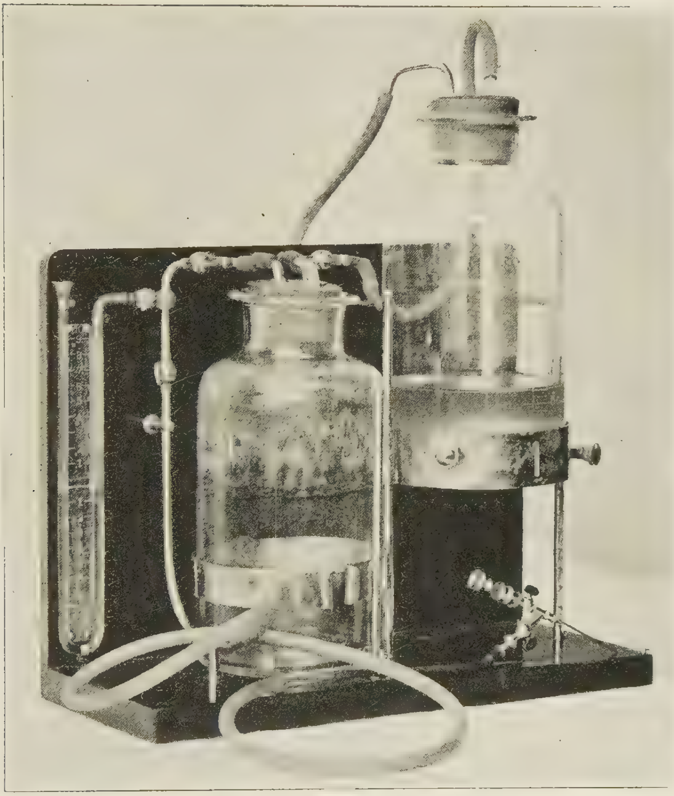


Fig. 51.—Floyd-Robinson pneumothorax apparatus.

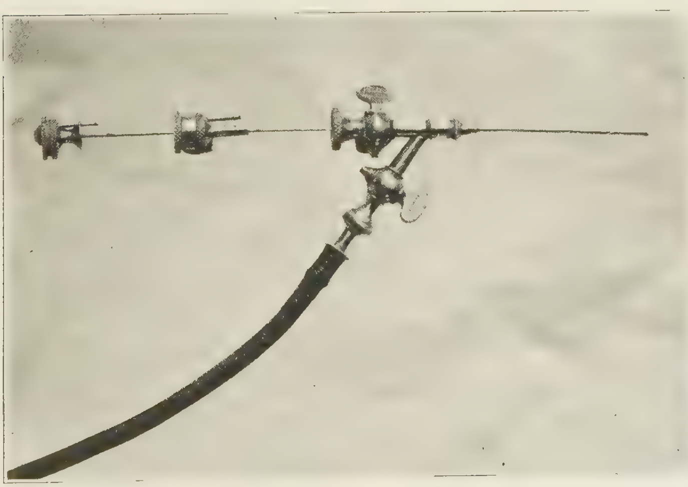


Fig. 52.—Floyd-Robinson needle.

over the axilla and back being quite tough. The site of insertion of The needle, with tubing attached to the manometer is inserted and the needle is usually the sixth or seventh interspace in the axillary line. pushed slowly into the tissues. The trocar is pulled out often and the manometer reading taken. When the manometer begins to fluctuate with respiration, and a negative pressure is recorded, it is known that the needle is between the two layers of pleura. The gas injection may then be begun. In a case in which a pneumothorax has already been created, it is easy to know when the pleura has been entered, as there is usually at that time a loud pop which can be heard anywhere in the room.

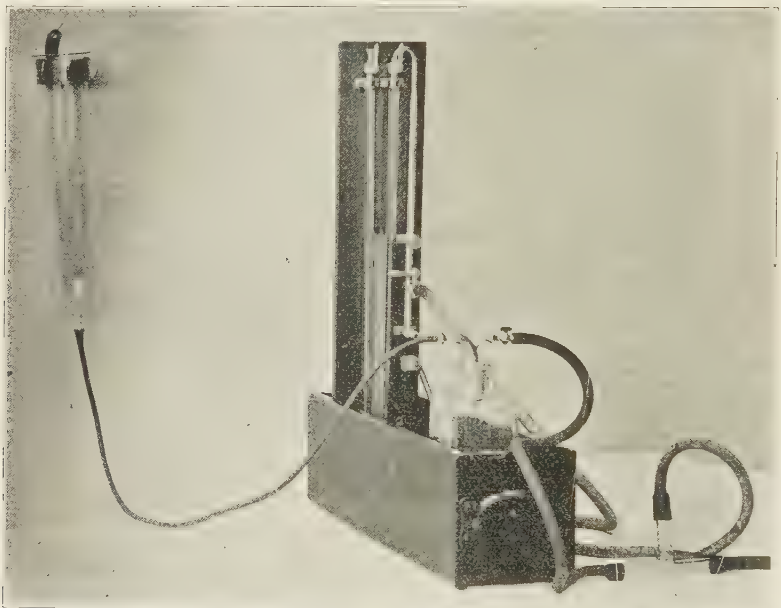


Fig. 53.—Homemade pneumothorax apparatus, made of gravity funnel, old blood pressure apparatus, Potain apparatus, cork and bottle.

After the gas is flowing, the manometer must be frequently consulted, as a guide to the amount of gas to be given. At a first injection 200 to 400 c.c. are sufficient, and even less than this if the manometer reading becomes strongly positive. The patient's sensations are a good guide to the amount to be injected both at the original and the subsequent operations.

**Pulmonary Tuberculosis.—**

For its use in pulmonary tuberculosis three conditions must be present:

1. *First, it must be used on an advanced case.* The patients who are suitable for this treatment are only those who have the prospect of a

fatal issue. Anything that we can do for them is a net gain. Some of them we restore to relatively complete health, and nearly complete activity. Some of them we make comfortable for a number of years, with measured usefulness in the world. And some of them we are unable to give any particular gain, but they are no worse off than when they began. The patient has everything to gain and nothing to lose. If the treatment is successful he is snatched from the prospect of inevitable death and is given from ten to thirty years of life, in comparative

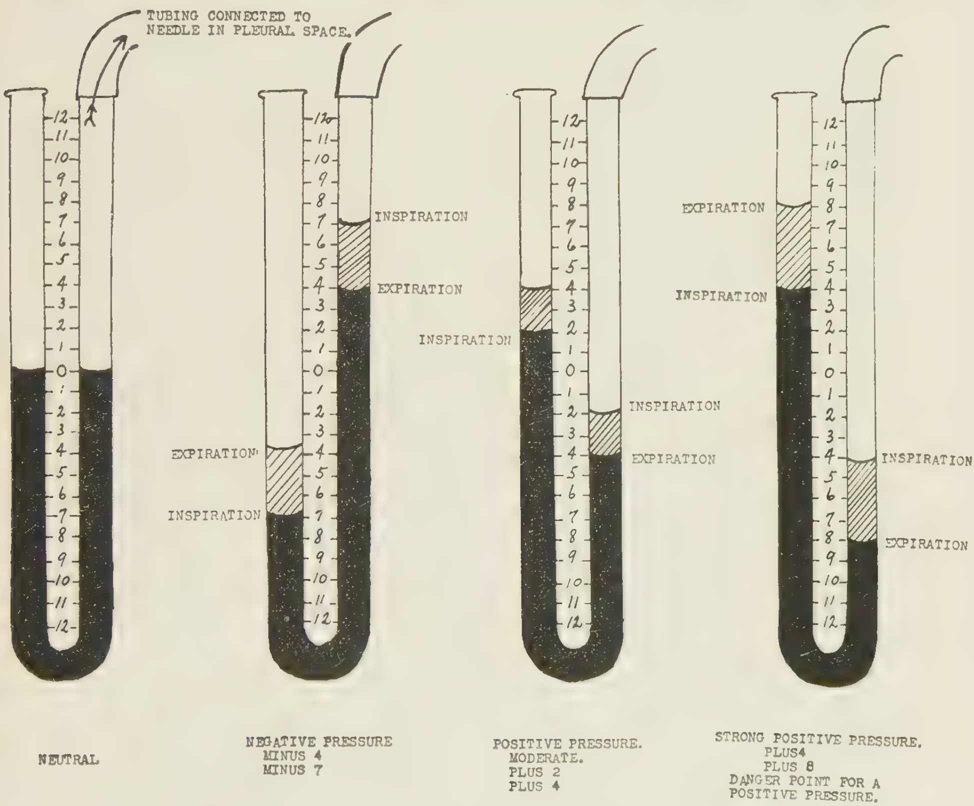



Fig. 54.—Detail of manometer and readings for pneumothorax.

health. If the treatment cannot be carried out, or if it does not produce great benefit, the patient is just where he was before.

In its earliest stages, the tuberculous process in the lung is an infiltration. The inflammatory reaction is either in between the alveoli, in the connective tissue, or else there is simply an additional catarrhal process in the alveolar mucosa; the two varieties have been usefully termed the interstitial and parenchymatous types, a classification that can be followed clinically, and also by the use of the x-ray.

The later stages of tuberculosis are a caseation. Here actual tissue destruction has led to deep patches of ulceration, discharging tubercle bacilli, in many instances going out into the bronchi, with the production of mucus and epithelial debris. The interlobular tissue inevitably becomes invaded, elastic tissue is replaced by scar tissue, or is largely absorbed, the contractibility of the lung is gone, cavities are formed, their walls flabby and only partially collapsed, or, often, as can be demonstrated in the x-ray, standing wide open.

What hope is there for a case of that kind? By extra feeding they can often be got into a state of semiobesity, and present some resemblance to a healthy though flabby individual. By rest, their respiratory activity is lessened, and their coughing diminished. By open air some hemoglobin is stored up, the fever reduced, and the bronchi soothed. But let them get about their usual activities again and all this carefully built up reaction vanishes; they crumble again to the consumptives that they were. The open cavities are still there, the ulcerations still open just a little with every intake of breath, the elastic tissue still cannot contract.

But if those cavities were compressed down, so that their walls touched, if drainage by pressure instead of by cough were afforded, if the respiratory movements were immobilized partially or completely, so that some attempts at healing could be made, the outlook for overalimentation, for rest, and for open air might be better. And it is that function which artificial pneumothorax performs.

2. *Second, the disease must be confined to one side of the chest.* Cases of this kind, i.e., advanced pulmonary tuberculosis confined to one side of the chest, are quite frequent. It is easy to understand why this rule should have been made. It is in the first place necessary when you contemplate putting one lung out of commission, to be sure that you have a sufficient surface of sound pulmonary tissue on the other side. In the second place it would not be of much benefit to collapse one caseous lung and still have another caseous lung from which absorption is taking place.

But it is to this second reason that certain exceptions may be noted. It is not infrequent that a marked process on one side will be found with very slight infiltration on the other. This was true in several of our cases, notably the one whose chart and plates are shown herewith (Figs. 55 and 56). When she first came under observation symptoms were very marked. She had dullness, much moisture and caseation over most of the upper lobe of the right lung. On the left side she had very distinct cogwheel breathing, an occasional râle on inspiration after coughing, but no dullness. The x-ray showed no change of the left side, but there was undoubtedly some small infiltration there, as shown by the physical

signs. After six months of compression of the right side, the changes in the left apex had entirely disappeared: there was no longer any cogwheel breathing, no longer any râle after coughing. The changes

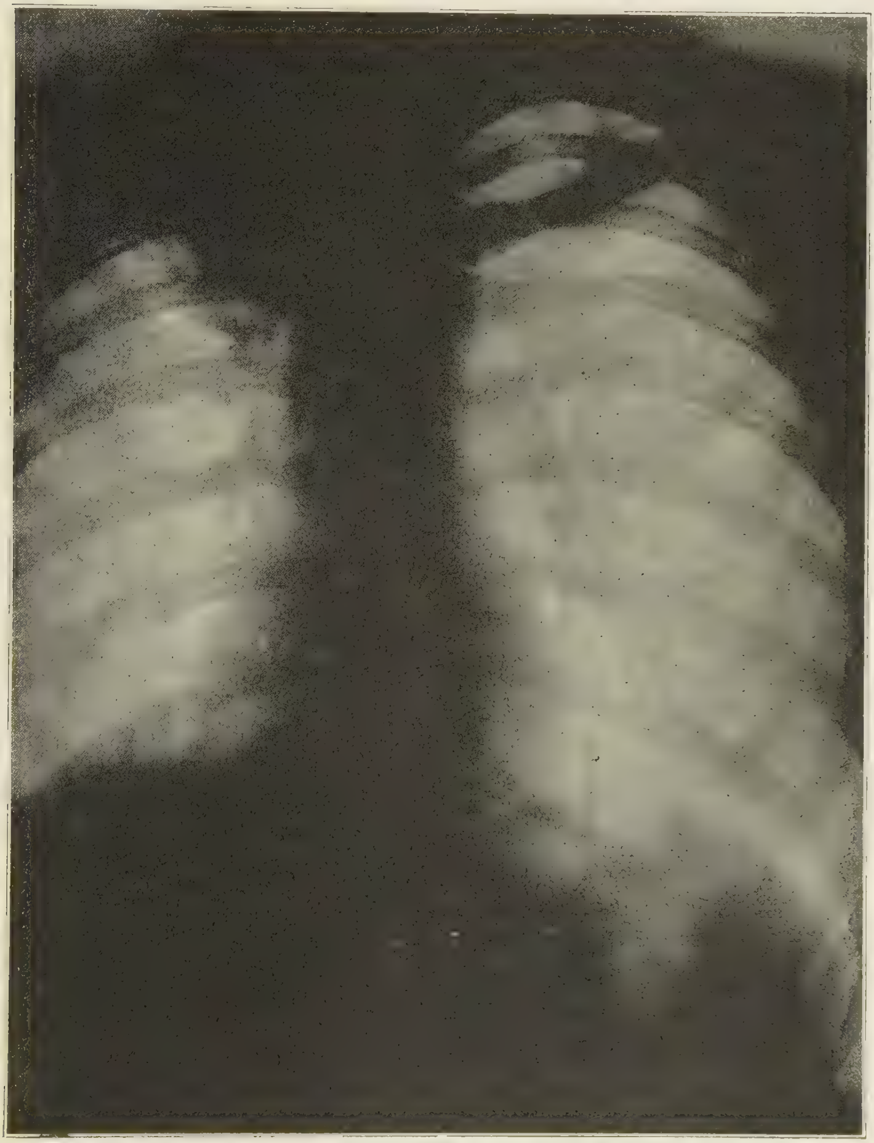


Fig. 55.—Artificial pneumothorax. Radiograph of the chest before collapse of right lung. Note advanced lesion in right apex only.

in the right lung were also marked: the lung was allowed to expand, and on examination, the moisture was nearly gone, and was replaced by a marked prolongation and accentuated intensity of expiration.

These changes in the opposite side can, of course, be explained by the favorable action which the drainage and cure of one infection has upon another in the body. The disappearance of the absorption in the right lung allowed the immune processes to assemble and attack the early infection in the left lung, with a successful termination.

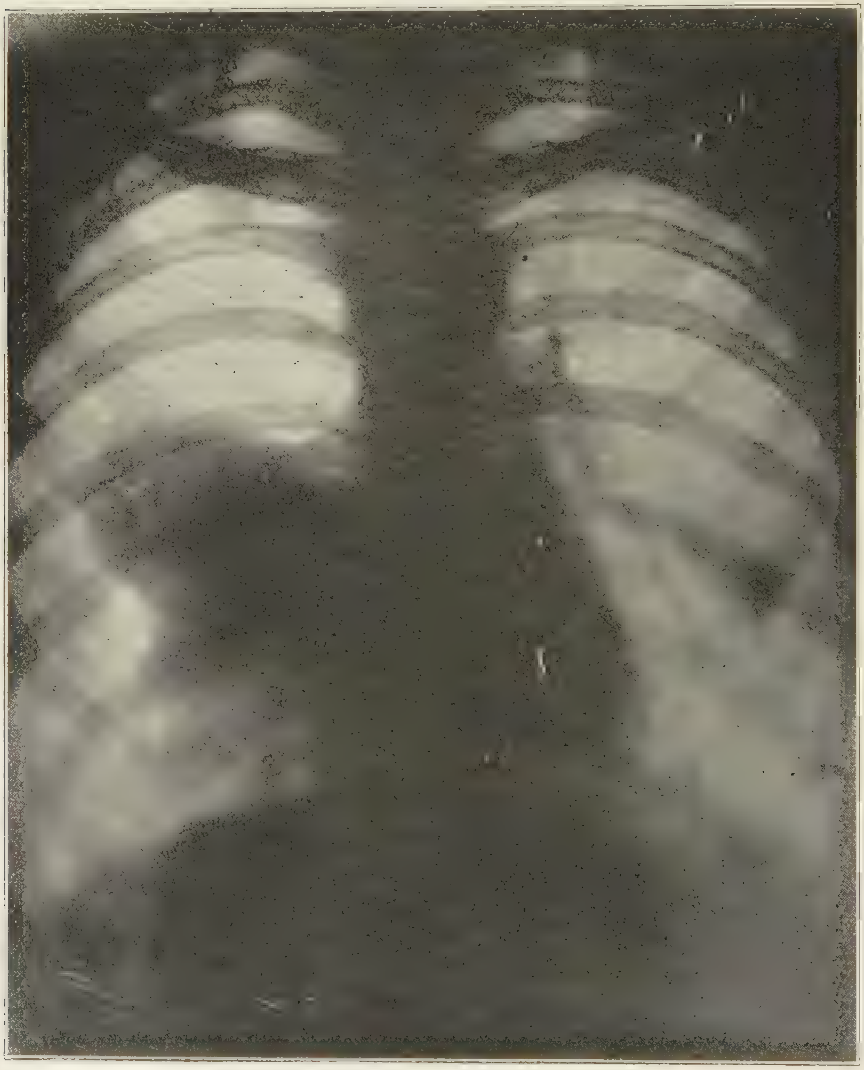


Fig. 56.—Radiograph of same case as in Fig. 55, after collapse of lung.

3. *Third, it must not be done in the presence of pleural adhesions.* It may be said at once that it is impossible to determine whether or not pleural adhesions are present, until the injection is tried. The use

any means of diagnosis whether physical or by the x-ray is, in our experience, quite inadequate, in this matter. A glance at the x-ray plate of Fig. 58 will serve to emphasize this point. You can see the large caseous process on the left side, midway in the lung. It lies, you see, at the outermost portion of the lung at the pleura, leaving no

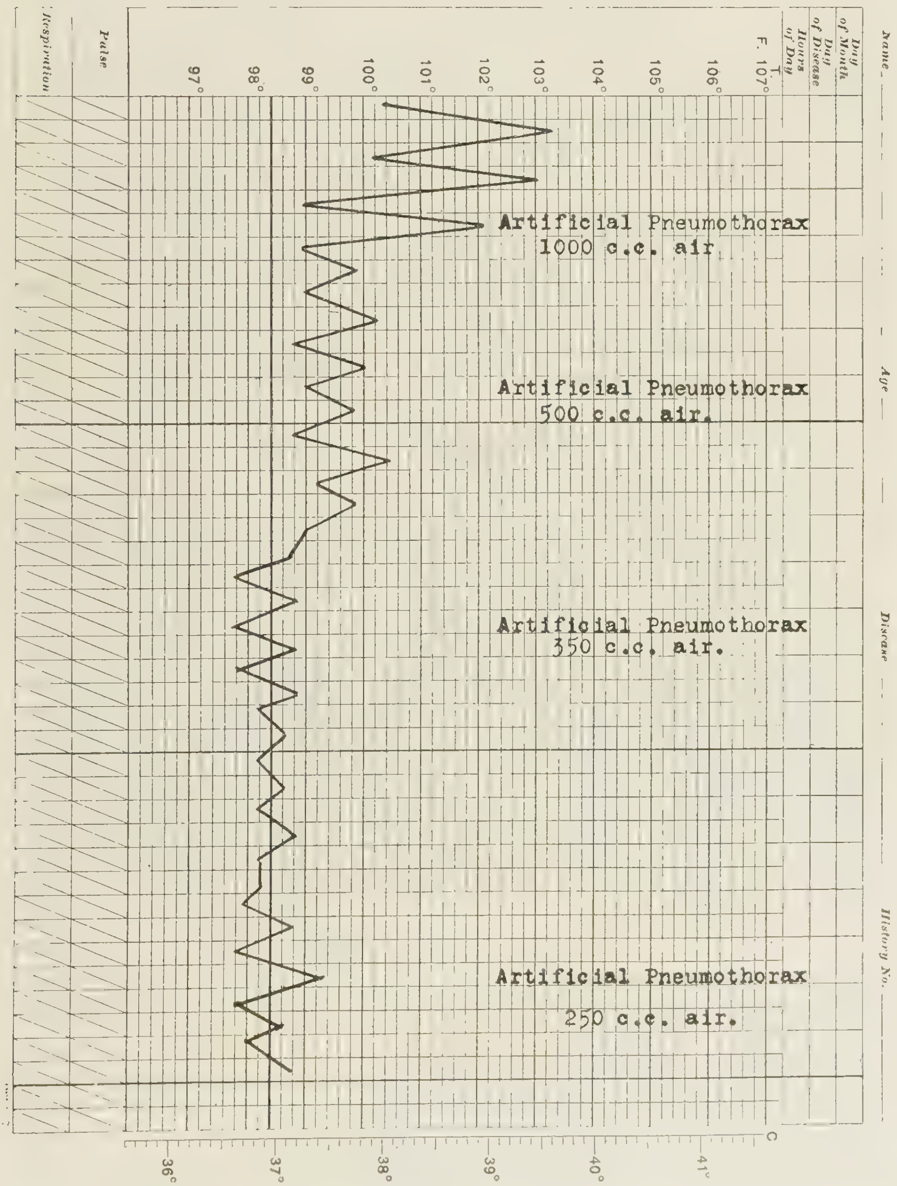



Fig. 57.—Temperature chart of case shown in Figs. 55 and 56, during first two weeks of treatment. Note high temperature before collapse and fall after collapse and drainage of lung.

air space to be seen between it and the wall. If ever we would be justified in saying that a process in the lung had caused pleural adhesions, we would be justified in saying that it had done so here. Yet the lung collapsed with great ease as is seen in Fig. 59, an x-ray picture made of the same case, after the injection of 2,000 c.c. of air in the chest. The

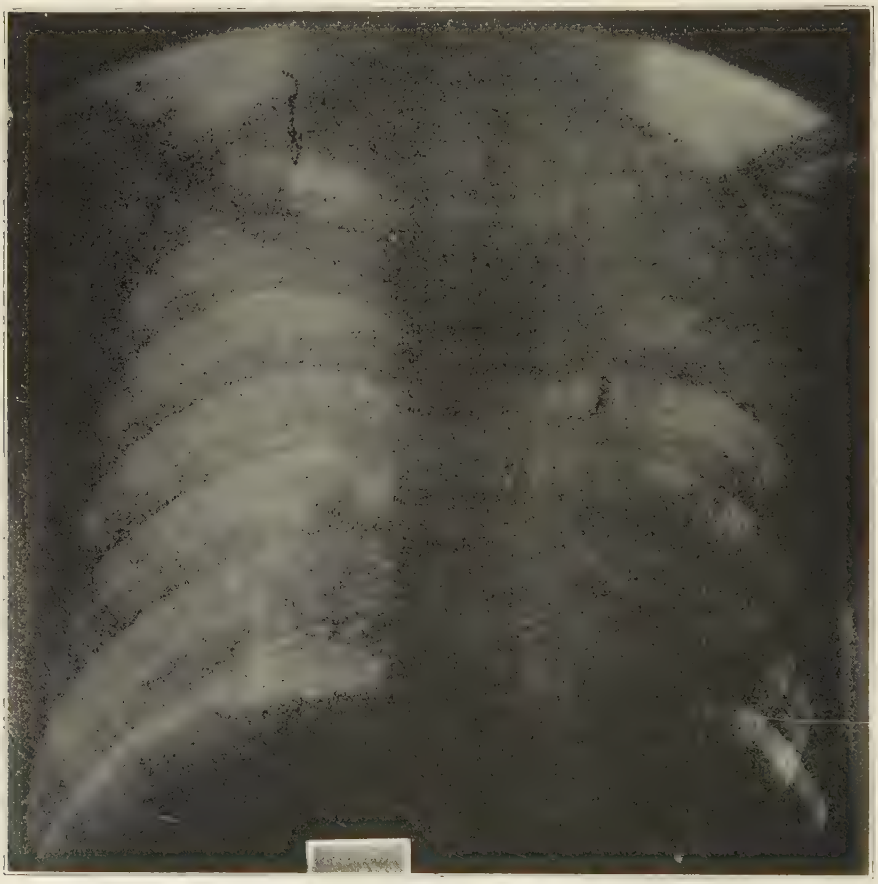


Fig. 58.—Artificial pneumothorax. Case II. Radiograph of chest before pneumothorax. The case illustrates very well the problems in the course of artificial pneumothorax treatment and they can be followed through studying Figs. 58 and 61. Note the extensive involvement of both lungs. There were tubercle bacilli in the sputum. (Temperature Chart, Fig. 61.) It would be hard to find a more hopeless case. It was decided, *in spite of the involvement of both lungs,* to produce pneumothorax on one side. This was done November, 1921.

position of the lung which we suspected of being productive of adhesions can again be identified and is seen well away from the chest wall.

In a very few cases it will seem that, at the first injection, the lung is held in place by adhesions and afterwards another injection will allow it to collapse. In these perhaps fine adhesions are broken in the

process. This is the exception to the third rule. It is, however, a rather rare occurrence, as the adhesions are usually so tough as hardly to be torn, with hands, at autopsy.

**Results in Tuberculosis.**—I have recorded above my somewhat enthusiastic opinion of this method. It may perhaps absolve me from accusation of too sanguine an outlook to state that this was not always my view of the subject. The first few cases upon which it was used did not respond sufficiently to appear to justify its use. For a time I discarded it altogether. Then a woman, upon whom it had been used in

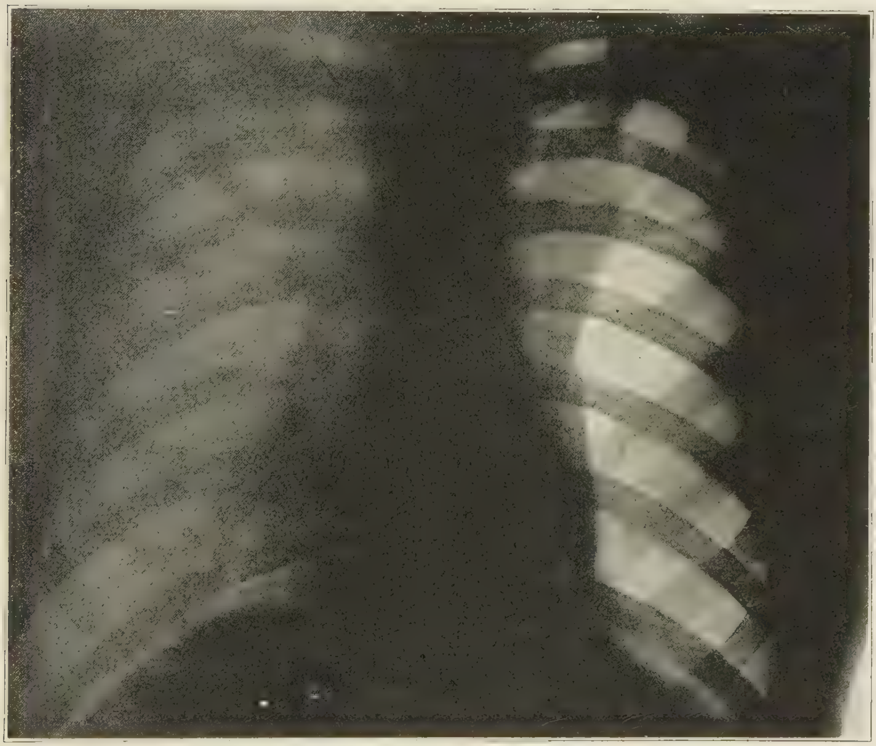


Fig. 59.—Case II. Radiograph of chest after production of pneumothorax on one side. December, 1921.

a Colorado sanitarium, came to us, asking that it be done upon her again. She had been compelled to leave Colorado, in order to attend to some business affairs. These kept her longer than she had expected, and there was no immediate prospect of her being able to return to Colorado. She was an intelligent well-trained tuberculous patient, the ideal product of a sanitarium; and she noticed, as the pneumothorax wore off, that not only was her temperature beginning to rise in the afternoon but also, that she was unduly fatigued.

We gave her an injection, and she expressed a great deal of pleasure at her immediate improvement. She was able after a few injections to walk a mile a day without developing a rise of temperature, whereas before she had not been able to move around at all without fever. She continued under observation for several years and is still alive and well.

This case convinced me of the efficacy of the method in proper cases. The simplification of the technic, using air instead of nitrogen, has added to the favor with which one naturally regards such simplification.

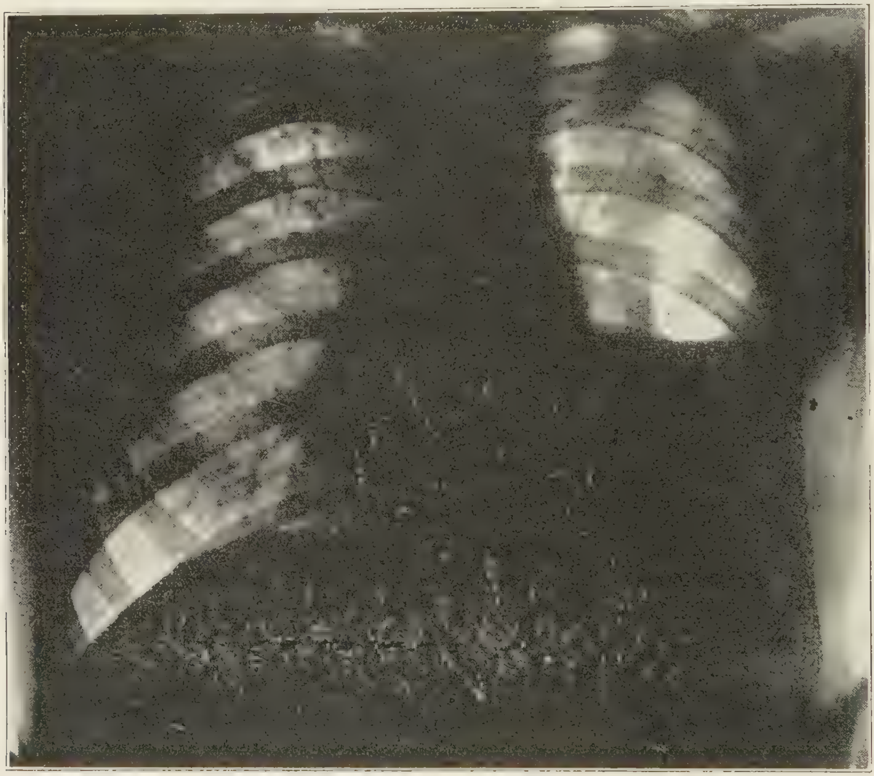


Fig. 60-*A*.—The occurrence of effusion in the pneumothorax side. A common accident. It was attended by a spell of fever and malaise. Patient upright.

The results, in statistical form, are in fair agreement from various sources. It may be stated that of the cases that are otherwise suitable for treatment in 15 per cent it cannot be done on account of adhesions. Sachs in 1915 reviewed the statistics of American authors, with the total of 1,108 cases followed, out of 1,147 cases done. The results are:

| | |
|---|---|
| Completely cured (after being followed for several years) .. | 12.3 per cent |
| Arrested (counted at first as cured) ...................... | 8.7 per cent |
| Improved .............................................. | 29. per cent |
| Unimproved ............................................ | 18. per cent |
| Died .................................................. | 16. per cent |
| Treatment discontinued on account of adhesions ........... | 15. per cent |

When it is considered that these statistics were gathered from a large number of physicians, at every stage of their experience with the method, and with every grade of temperament in judging what is an unimproved case, and when further it is remembered that these are all advanced cases, results of cure in over 12 per cent of these cases seem to me quite remarkable.

Brauer and Spengler in 1910, reported on 88 cases, as follows:

| | |
|---|---|
| Cured | 33. per cent |
| Improved | 40. per cent |
| Unimproved | 14.7 per cent |
| Died | 21.8 per cent |

Their cases were, I believe, not so carefully followed or collected as Sach's but it is interesting to note the very high number of cures they claim.

**Special Technic in Tuberculosis.**—1. *Amount of the initial injection.*—Opinions differ on this point. Forlanini introduces 300 to 400 c.c. of gas on the first occasion. Morelli even less. I have introduced as much as 1,800 c.c. not, however, without symptoms of shock. The best rule seems to be to introduce a fair amount, so that the patient will not have to be subjected too soon to an operation which he dreads, but not enough to cause shock. The amount varies with the size of the chest, roughly from 500 c.c. to 1,000 c.c. of air.

2. *Frequency of Injection.*—During the initial period, air should be introduced once every three or four days. Every other day is too frequent, and five days too long. When the lung has completely collapsed, as shown by fluoroscopic examination, the injection should be made once a week or once every two weeks, and later once a month. It is difficult to lay down a hard and fast rule about this. The feeling of the patient, and especially the x-ray picture, should be the criteria of judging. In certain cases of patients over forty years of age, the lung tissue is very resistant, and frequent and large amounts of air must be introduced. Not much help can be had, in our experience, by determining whether there is a neutral or positive intrathoracic pressure. Morelli, however, advises to maintain a neutral pressure, but adds that in very resistant cases, with a cavity which does not collapse with the rest of the lung, a positive pressure may have to be obtained.

It is important to know how much gas is absorbed. Forlanini states that in the initial period 100 c.c. are absorbed per day, and later about one litre a month. Morelli does not entirely agree with these figures.

In many cases, various complications occur and prevent the regularity of the injections. Pain from tearing adhesions, collapse of the opposite lung, or fatigue and restlessness are some of these.

3. *Length of time collapse should be maintained.* If improvement is steady the lung should stay collapsed at least two years. At the end of that time it may be allowed to expand and the result watched. If temperature rises, and expectoration increases, collapse should be done for another year. It is sometimes maintained for ten years or indefinitely.

**Acute Hematothorax.**—It has often been said in the literature of artificial pneumothorax that it is the most useful, in fact the only effective treatment we have in bleeding from the lung. Ringer states: "Though

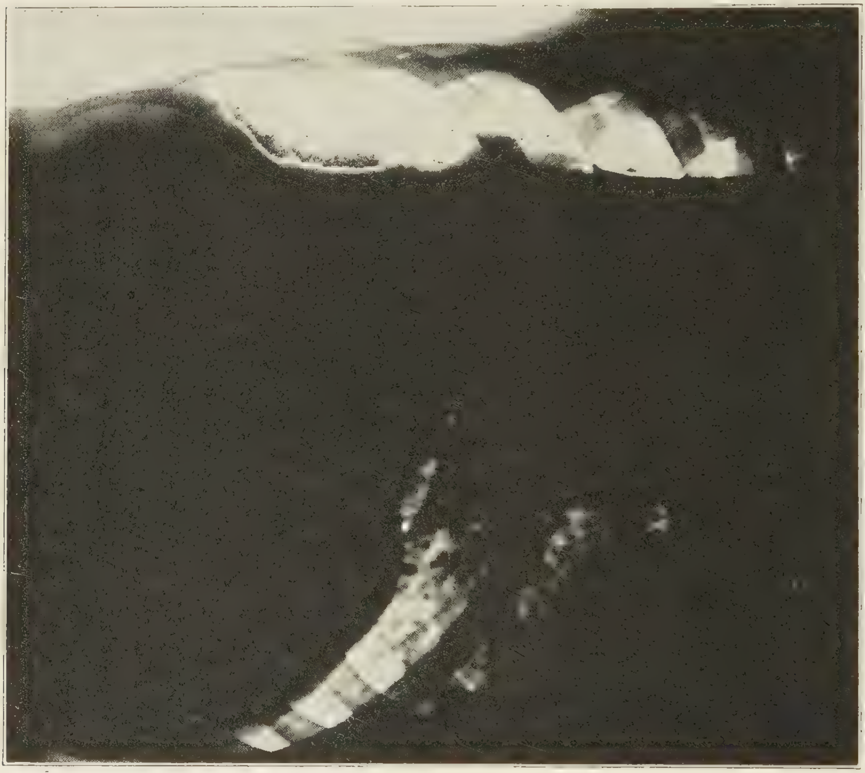


Fig. 60-*B*.—Same as Fig. 60-*A*. Patient on right side. The fluid, as all fluids in cavities containing air, is movable. There is always a question what to do when fluid forms. It often keeps the lung collapsed and is a good thing. In this case the patient did not do well with the fluid and it was removed and collapse again maintained. April, 1922.

the number of cases in this class is small, yet the results have been so brilliant that I strongly advocate using gas for checking hemorrhage, if severe or protracted." This refers, of course, to hemoptysis in tuberculosis.

Peters advises giving pneumothorax as a preventive measure in bleeding cases, and points out that it should be given during the intervals be-

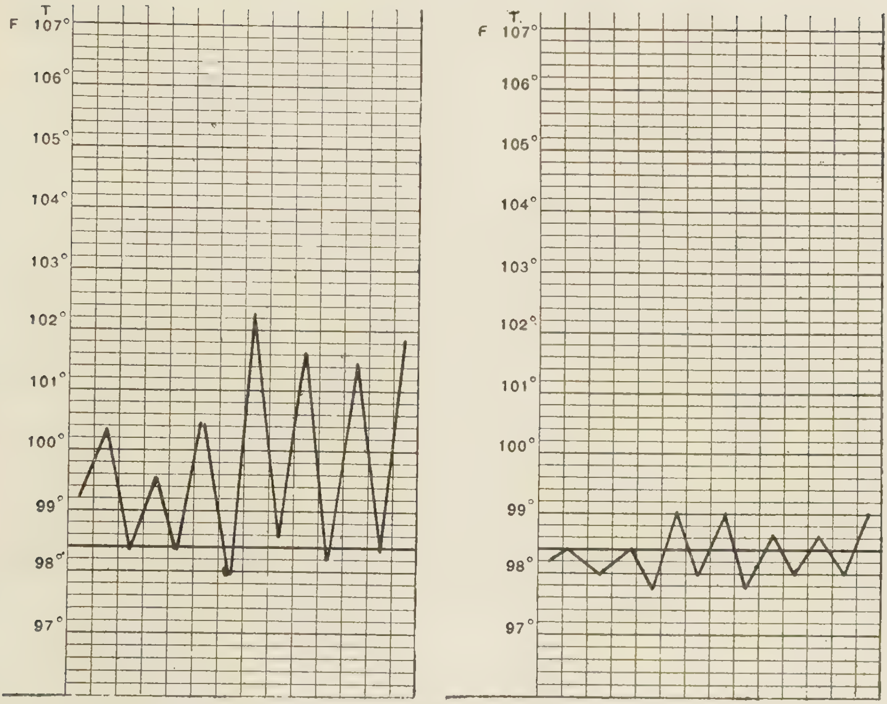



Fig. 61.—Case II. Temperature chart for one week before pneumothorax treatment was begun, and for one week six months later.

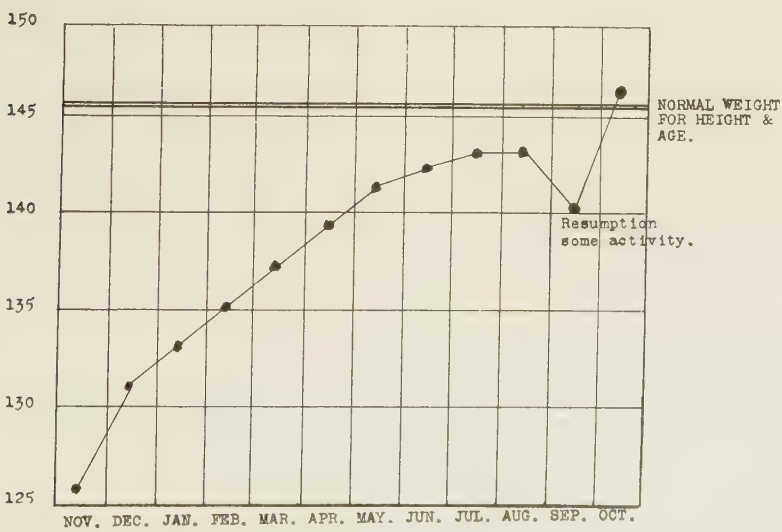



Fig. 62.—Case II. Weight chart of patient for first year of pneumothorax treatment.

tween hemorrhages, as this offers the patient a better opportunity to react.

The procedure is also useful in cases of gun-shot wound of the chest, in which there has occurred a hematothorax but in which the lung is still bleeding. The fluid should be evacuated first, and then the pneumothorax induced.

**Acute Lung Abscess.**—We have only had experience with the treatment in one case of this character, but Dr. Tewksbury of Washington has used it in 19 cases with splendid success. He has cured over 73 per cent with about 20 per cent mortality. This is contrasted with a cure of only 10 per cent of cases under medical treatment.

A glance at the radiograph of one of these cases will show that the cases are ideal for pneumothorax treatment. The disease is extensive, is confined to one side, and does not reach the periphery in many cases, hence does not cause pleural adhesions.

**Bronchiectasis.**—We have tried pneumothorax in one case of bronchiectasis, with improvement, but not complete cure. It is when the bronchiectatic wall has broken down, and the disease has invaded the lung tissue that the best results are likely to follow—in other words, the advanced case. Here the possibility of collapse of the infected tissue is greater than when the suppuration is still inside the hard walled bronchi.

**Pleural Effusion.**—Weil has injected air in the pleural cavity after removing the fluid of 50 cases of serofibrinous pleurisy. He believes it prevents adhesions and secondary difficulties. He compares his 50 cases, 82 per cent of which recovered without adhesions, with 86 cases treated without air injection, 84 per cent of which had marked sequelae a few months or weeks later. He believes that collapse of the lung in these cases prevents the development of the effusion. We have had no experience with the method.

## V. TECHNICAL PROCEDURES USED IN GASTROINTESTINAL DISEASES

### A. Dilatation of the Esophagus

**Stricture of the Esophagus.**—Some form of stricture is the only common clinical disease of the esophagus. It may be due to various causes. *Cancer of the esophagus* is the most frequent. *Cicatricial stenosis* due to the swallowing of caustics, either with suicidal intent or accidentally, is met nearly as often. *Cardiospasm* is, however, not a very rare condition. *Syphilis of the esophagus* is found more frequently in textbooks than in practice. It may occur during the secondary stage of syphilis

due to mucous patches in the esophageal mucosa. "During the terrible pandemic of fulminating syphilis late in the 15th Century a frequent cause of death was starvation due to aphagia resulting from secondary esophageal syphilis." (Mills.) *Gumma of the esophagus,* ulcerating and causing cicatricial constriction, is a cause of stenosis.

In the treatment of these cases the point of attack must always be the nutrition of the patient. This platitude is often overlooked by enthusiastic technicians. There is no use treating syphilis of the esophagus alone or applying radium to a carcinoma, or dilating a stenosis under esophagoscopic control, while the patient is starving for lack of food.

The first and most useful procedure, then, in the treatment of esophageal stricture is the surgical operation of gastrostomy. This makes an opening in the stomach through which a tube passes; the patient chews his food and spits it into the tube so that it enters the stomach. Nutrition may be maintained in this way indefinitely. All cases of esophageal stricture, of course, are not to be submitted to gastrostomy: but it should always be kept in mind as a safe and valuable procedure.

**Methods of Dilating the Esophagus.**—Only three can be recommended:

*Dilation by Graduated Bougies under Esophagoscopic Control.*—This is the method of choice in strictures of high grade due to burns from the swallowing of lye and other caustics.

*Technic.*—"When the esophagoscope is to be introduced, the patient, sitting on a low stool, with some one in a chair beside him supporting his back, throws his chest somewhat forward and his head as far back as possible. By this means the mouth, pharynx and esophagus are brought into line. The pharynx is thoroughly anesthetized with a 10 per cent solution of cocaine. The patient is instructed not to swallow immediately after the applications are made. The esophageal bougie, extending about six inches beyond the end of the esophagoscope, is introduced with it, the patient's head being dropped forward. As soon as the tip of the bougie passes over the epiglottis, the patient is instructed to throw his head back as far as possible, and the instruments are slowly thrust downward until the end of the esophagoscope is felt to pass over the cricoid cartilage. This sensation is a very definite one to the operator. The bougie is then slowly removed, while the esophagoscope is held in position. By means of the Bruning handle lamp the light is then thrown into the esophagoscope, the further progress of which is under the constant guidance of the eye. In this manner there is practically no danger from the introduction." (Aaron.)

*Dilation by the Introduction of Graduated Olivary Tips Guided by a Thread.*—This method may be used in strictures in which the opening is large enough to admit a small olivary tip, and which are capable of

dilation (that is, which are not impermeable due to tough scar tissue). It may be tried in all cases where an esophagoscope is not available. It is applicable also to cancer of esophagus after radium treatment, if stricture has resulted.


A. B.

Fig. 63.—Various methods of treating esophageal strictures.
*A*. The use of radium in a carcinoma of the esophagus.
*B*. The use of the graduated olivary tips to divulge a cicatrix of the esophagus.

The use of the thread for guidance makes the method safer than the introduction of the stiff esophageal bougie. One end of the thread is swallowed and washed down with a glass of water. The end of the thread will trickle through even the smallest opening and into the

stomach. When it has gone on into the intestines and several yards have been swallowed it will be anchored sufficiently so that traction can be made upon it. Then the olivary tip can be threaded upon it and guided to the stricture.

The olivary tips in the instrument designed by Sippy are screwed end to end upon a piano wire. They gradually increase in size and then


Fig. 63-*C*.—The use of the Plummer dilator in cardiospasm.

gradually decrease in size with the bulbs pointed the other way, see Fig. 63-B.

This arrangement allows them to enter the stricture easily, and then if the middle part is passed a gradual dilation is provided for on the return.

*Dilation by the Rubber Bag Method of Plummer* is applicable to cardiospasm alone and is described in detail below.

*Dangers of Esophageal Sound.*—Nearly every pathologic museum has a specimen of an esophagus which has been perforated by an instrument which has made a false passage in attempting to dilate an esophageal stricture. Mediastinitis and lung abscess and gangrene result. The accident must always be thought of but is particularly likely to happen when an unguided stiff instrument is used.

**Treatment of Cancer of the Esophagus.**—The application of radium to cancer of the esophagus offers some slight hope of relief to a condition that has always been fatal. Suter reports three cases out of six treated by radium well after several years. Mills and Kimbrough report one patient alive and apparently cured eighteen months after beginning treatment. Hanford has four cures out of fifteen cases.

The technic of application is described on page 397.

**Treatment of Cardiospasm.**—Cardiospasm is a functional stricture of the esophagus due to spasm of the cardia. In some cases dilatation of the esophagus results. The cause of the spasm is unknown. As Plummer and Vinson say after a study of 301 cases no theory as to etiology satisfactorily explains all the cases. In some it seems to be reflex due to intraabdominal disease such as cancer of the stomach or gall bladder disease. (Carlson, Boyd and Pearcy have shown in cats that mechanical stimulation of the gall bladder and mechanical and clinical stimulation of the stomach cause hypertonus and spasm of the cardia.) In other clinical cases no such intraabdominal disease is found. Plummer particularly states that patients with cardiospasm are not usually neurasthenics and my experience agrees with his.

In the treatment of cardiospasm dilation with small bougies or olivary tips is not sufficient. Forceful stretching of the cardia must be done. This is best accomplished by the instrument designed by Plummer. This consists of a stiff hollow rod, which has a rubber bag bound over the opening at the distal end; the proximal end connects with a rubber tube which is attached to a water faucet. Into this tubing is tapped an offshoot to a gauge, and a tubing used as an outlet for regulating pressure. It requires some practice to introduce the tubing and to have it engage in the cardia. When engagement has occurred the water is turned on and the rubber bag distended thus dilating the cardia. A pressure of 20 to 25 feet of water will give moderate distention. A pressure of 30 is safe. One or two such dilations are sufficient, though recurrences are common.

In the Mayo's early series, before Plummer invented his instrument, gastrostomy was frequentlv performed, and manual dilatation of the cardia done. The gastrostomy was justifiable in these cases on account of the emaciation. Since the use of the forcible instrumental dilatation operation has been unnecessary, of 246 patients traced by Plummer and Vinson 6.9 per cent died (many from intercurrent disease) and 76 per cent were completely relieved. Seventeen per cent were improved, and 6 per cent no better.

### B. Gastric Lavage—Duodenal Drainage

Lavage, or mechanical emptying of the stomach, was first practiced by Kussmaul in 1867. His description of the first case is so graphic and so well summarizes our modern ideas of the value of lavage that I will

Fig. 64.—Duodenal biliary drainage. Step one. Patient preparing to swallow Rehfuss tube.

quote a large part of it. The patient was a girl of twenty-five years of age who had apparently a pyloric ulcer with stenosis and consequent dilatation of the stomach. She had been vomiting for several years.

"Quite frequently, when I observed the patient in the miserable prodromal stage of vomiting, the thought had occurred to me that I might ameliorate her sufferings by the employment of the stomach-pump, as the removal of large masses of decomposed gastric contents should cause the agonizing burning and retching at once to cease. The intro-

duction of the esophageal sound was naturally not difficult, for where a gastric dilatation has existed for so long a time the esophagus also is usually dilated. The artificial emptying of the stomach by the pump could be no more painful or distressing than her condition before and during vomiting. At all events, it would be more rapid and complete than the natural emptying of the stomach by the act of vomiting, with its prolonged prodromal stage of nausea, pain and retching. Repeatedly, even after vomiting, palpation and percussion revealed that the stomach still contained considerable masses. This condition reminded me of the so-called ischuria paradoxa, in which large amounts of urine flow daily from the dilated bladder without its actually becoming empty and without contracting completely, and, if its elastic and contractile powers have not been entirely exhausted, perhaps even give to it the tone to contract to its smallest extent, just as the catheter occasionally brings about recovery in ischuria paradoxa.

''In our patient the gastric dilatation was due to constriction of the pylorus. At the autopsy of cases of extreme gastric dilatation I had repeatedly observed that the stenosis which caused them would still permit the passage of a small finger from the stomach into the duodenum, although towards the end of life there had appeared to be complete closure of the pylorus. In such cases I had occasionally noted at the bedside through the abdominal covers active movement in the stomach. A paresis of the gastric musculature might be present, but certainly not complete paralysis. It appeared to me as though the excessive distention, the filling and overloading of the stomach itself, produced a mechanical action which increased the constriction of the pylorus to complete closure, and this condition I hoped to remove by emptying the stomach and decreasing its size.

''Finally it appeared that the employment of the stomach-pump would permit a more active topical treatment of the diseased gastric mucous membrane than was formerly possible. In the case of our patient this organ had for years been continuously irritated by extremely acid contents. The retention, stagnation, and decomposition of masses of food in the stomach because of pyloric stenosis is certainly often the cause of the catarrh of the mucous membrane; as, for example, in cases in which originally there was but an ulcer or a cicatrix of the pylorus, the stomach being otherwise intact; in all other cases it probably maintains and increases a catarrh already present. This is probably why we note so constantly, in constriction of the pylorus, that the mucous membrane about the pylorus, where the gastric contents especially accumulate, shows most intense disease. The stomach-pump, I hoped, would not only

make it possible completely to evacuate these acid, irritating masses, but would also permit the washing and cleansing of the diseased mucous membrane which had been irritated by acid and alkaline fluids, as, for instance, with Vichy water or with an artificial soda solution.

"The introduction of the stomach-tube, the pumping out, and the washing with Vichy water were unexpectedly easy. We withdrew three liters of acid, dirty gray, sarcina-containing fluid, with particles of food of all kinds undergoing softening and decomposition.

"Even the immediate result of the first emptying and washing of the stomach with Vichy water was a surprisingly beneficial one. The patient who was previously always exceedingly disagreeable, and of such a whining disposition that she well bore her name, 'Weiner' (crier), appeared a few hours later as if completely transformed. For the first time she was agreeable and appeared comfortable in her bed, and she declared that for years she had not been in such good spirits. She at once digested and slept much better, and for two days was entirely free from depressing sensations in the stomach. After repeated employment of the pump, at the end of fourteen days the patient had a more healthy appearance and had become another being. She who had always been disagreeable, had lain in bed or reclined in an armchair, was up the whole day, was very friendly, and attempted to make herself useful about the room, and soon in other parts of the house. In the first three months of her stay in the hospital, and before the employment of the pump, she had gained at most 5½ pounds in weight; two months afterwards she had gained at least 16½ pounds, and in not quite six months, 24 to 25 pounds. For two years recovery has been complete, although the patient is by no means in easy circumstances."

The apparatus used by Kussmaul survives to us only in name—the term stomach-pump. What Kussmaul used was indeed a pump. As an illustration of how unfamiliar it is, several years ago by the death of an uncle who was a practitioner, I came into possession of a number of instruments, some of them used by my grandfather. Among them was a large brass syringe-appearing apparatus, in a rosewood box, with a set of wooden mouthgags, etc. I had no idea what it was and showed it to several of my senior medical friends; none of them was able to give it a name, and its use was a mystery until I found in Bassler's "Diseases of the Stomach" an exact picture of it labelled Kussmaul's stomach pump. In that book I also found the excerpt from Kussmaul's original description.

The indications for emptying the stomach which Kussmaul gave are exactly what they are today. The wheel has come full circle. There

was for a time a great enthusiasm for gastric lavage, and dyspeptics of all kinds had their stomachs washed daily. The results were not by any means always good, so that today gastric lavage is used almost exclusively for the stagnation of pyloric stenosis due to ulcer or cancer.

The technic, however, has changed greatly. Kussmaul used a stiff tube. It was soon discovered that a soft rubber tube would pass through the esophagus and enter the stomach just as readily.

The greatest refinement of technic consists in the use of the Einhorn tube or the Rehfuss tube. These consist of small metal tips with perforations in the side attached to a very small tubing. The patient must

Fig. 65.—Duodenal biliary drainage. Step two. Tube swallowed. A sip of water used if necessary.

be taught to swallow the metal tip as the tubing is not stiff enough to push down the esophagus. The tube may be left in for hours or days if desired in order to study the curve of gastric secretion, to aspirate bile or to administer duodenal alimentation.

It is not difficult to teach most patients to swallow the metal bulb. It should be put far back in the pharynx and the patient instructed to hold the chin down: this is the natural attitude for swallowing. We do not swallow with the head thrown back, although it seems instinctive on the part of physicians to tell patients to hold the head back when they attempt to swallow the bulb. The patient must continue swallowing movements even though gagging somewhat. A sip of water

in the mouth at the same time the tube is swallowed may facilitate the procedure. After the tip is past the glottis and engaged in the esophagus gentle pushing on the tube will give it an impetus, although it must be seen that the tube is not simply coiling up in the mouth.

Once in the stomach, it is easy to pass the tube into the duodenum. The stomach should be empty. After the tube is swallowed the patient is instructed to lie on the right side. The tube will pass into the duodenum in from twenty minutes to forty-five minutes. Aspiration should be done every five or ten minutes: when the duodenum is entered the reaction of the contents becomes alkaline and is bile stained.

Fig. 66.—Duodenal biliary drainage. Step three. Patient has lain on right side twenty minutes. Tube in duodenum. Warmed 50 per cent magnesium sulphate solution slowly injected in through the tube.

Lyon has introduced the profession to a method of draining the gall bladder through a duodenal tube. He followed a hint of Meltzer's to the effect that magnesium sulphate acted by the law of contrary innervation, and that a 25 per cent solution applied to the duodenal mucosa would relax the sphincter of Odii, guarding the opening of the common bile duct, and at the same time cause the gall bladder to contract. In practice, after the bulb is in the duodenum 50 c.c. of a 25 per cent solution of magnesium sulphate is introduced into the duodenum very slowly and gently, with a Luer syringe. In three minutes suction is begun, and afterwards the bile allowed to flow from the tube end as it enters the duodenum. (Figs. 65 and 66.)

### C. Paracentesis Abdominis

The withdrawal of the fluid accumulated in the peritoneal cavity in ascites is usually advisable as soon as the accumulation is evident in cirrhosis of the liver, and when it is uncomfortable and cannot be controlled by other measures in cardiac and renal disease.

The technic of the procedure is simple. The preparatory treatment is for the patient to empty his bladder. The patient should, if possible, be in the sitting posture, on a chair. The knees should be separated, which in a case of ascites will give easy access to the site of the introduction of the trocar; the trocar should be of good size and fitted with a handle. With the patient sitting the site for the introduction of the trocar is in the median line, about ⅓ of the way from the symphysis to the umbilicus. The intestines are floated on the surface of the fluid above this point, and the bladder being empty there is no danger from that source. When the patient is recumbent the midaxillary line is selected.

Local anesthesia is advisable but not necessary. If intestinal loops stop the flow, they may be pushed out of the way with a catheter thrust through the cannula. The incision is closed with adhesive plaster after the cannula is removed.

### D. The Fitting of Corsets

A corset for the purpose of supporting the abdominal wall and maintaining the viscera in place during the early stages of the treatment of visceroptosis, until the muscles have been strengthened by exercise, and the inside of the abdomen contains a proper quota of fat, should fulfil two main conditions:

1. Comfort.
2. Efficiency.

**1. Comfort** is perhaps equally as important as efficiency, because if the corset is not comfortable the patient simply will not wear it. Many special manufacturers of corsets make very efficient corsets but they are so heavy, so cumbersome, contain so many straps, and require so much time to put on that the patient wearies of well doing and leaves the corset off. *Lightness* then is the first requisite; as much lightness as is compatible with strength. *Ease of adjustment* and *rapidity of adjustment* come next. *Freedom from extra straps,* especially perineal straps which manufacturers delight in, and which are irritating, and exceptionally uncomfortable, should be particularly required.

**2. Efficiency.**—The following points should be noted:

a. The corset should be snug over the hips and loose over the lower ribs. This tends to make it pull upwards, which is its object. If it is tight over the bust, narrow in the middle and loose over the hips it tends to push downwards—pushing the viscera down also.

b. It should support the lumbar spine, often flattened in these conditions. Extra ribbing in the back will do this.

c. It should tend to throw the shoulders backwards and upwards, i.e., high behind.

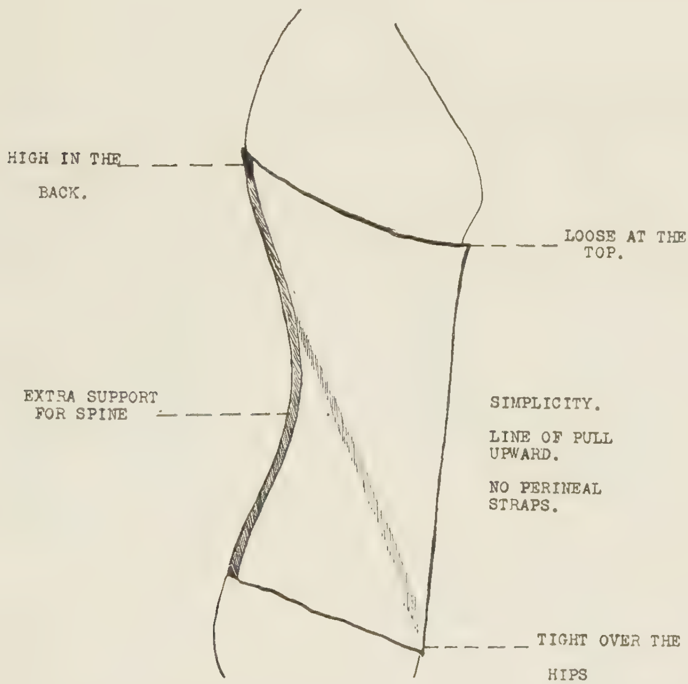



Fig. 67.—Points about the fitting of an effective corset for visceroptosis.

## E. Use of the Sigmoidoscope in Treatment

**1. Technic of Sigmoidoscopy.**—a. *Selection of instrument.*—In Fig. 68 the arrangement of the instrument table for sigmoidoscopy is shown. The instrument I use is a simple tube with the electric lamp in the inner end. Some instruments are made with the light in the eyepiece, but I think the other arrangement gives better illumination. I should like to draw attention to the smaller caliber of the two sigmoidoscopes compared to the others. These can be especially made smaller than the in-

strument usually sold and can be introduced even into a very sensitive rectum with practically no discomfort. I do not use any bag for distending the bowel forcibly with air because the proper introduction of the sigmoidoscope allows enough air to enter the bowel to balloon it quite satisfactorily.

b. *Position of Patient.*—The patient is always put in the knee-chest position if possible, that is, if not too weak and sick. The sigmoidoscope can be introduced, however, with the patient on the side.

c. *Introduction of Sigmoidoscope.*—The physician wears a finger cot anointed with a lubricant, which is also smeared over the tip and outside of the instrument. With the patient in the knee-chest position and the

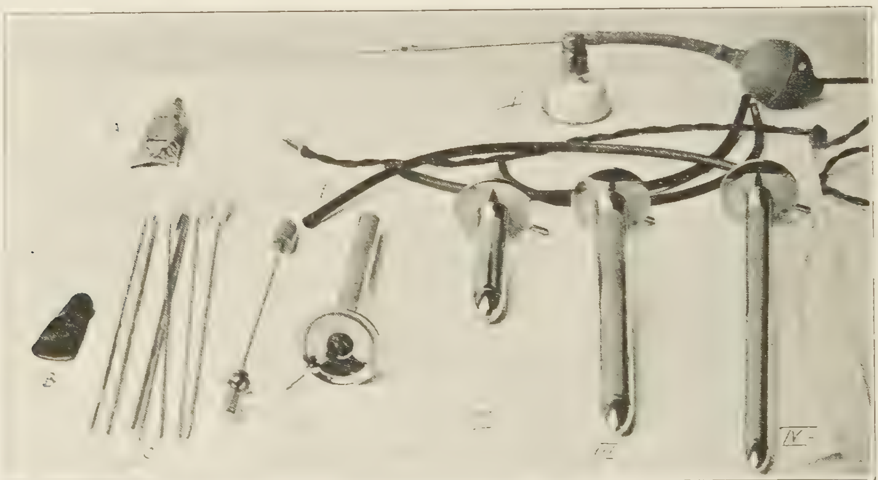


Fig. 68.—Arrangement of table for sigmoidoscopy.

*A*, Lubricant; *B*, finger cot; *C*, swabs on long, heavy applicators; *1*, *2*, *3*, and *4*, different sizes and lengths of proctoscope; *D*, DeVilbiss instillator with barium-calomel powder and extra long nozzle; *E*, catheters and electric light connection.

obdurator inside the sigmoidoscope, it is gently pushed past the sphincter and for an inch or two into the rectum. This should cause no pain; in fact, the whole procedure should be quite painless. After it has been introduced up to the place where slight resistance is offered by the rectosigmoid juncture, the obdurator is removed and the battery turned on so that the operator guiding the instrument by sight and allowing the bowel to distend by air can gently introduce it around the sigmoid curves further and further up the bowel until every inch of the rectum, sigmoid, and part of the descending colon can be thoroughly inspected.

2. **Appearance of the Normal Rectosigmoid Canal.**—It is seldom necessary to have the patient empty the bowels deliberately by the use of an enema. I never order a cathartic the night before. If on introduction

of the instrument the sigmoid is seen to be full of feces, it is removed and evacuation permitted before reintroduction. Usually there are only a few fecal flakes to be seen hanging to the walls of the gut, and these can be removed by the large applicators fitted with cotton swabs.

Starting from the anus we see hemorrhoidal veins and the crypts of Morgagni, and ulcerations and other pathologic conditions around the anus. These can best be seen, however, at the end of the procedure as the instrument is being removed.

The color of normal rectal and sigmoid mucosa is a delicate clear pink; some small vessels can be seen but are usually the evidence of disease. A dark red color seen in the sigmoidoscope always indicates ulceration or carcinoma even if the disease cannot be distinctly focused.

The rectosigmoid juncture is marked by a distinct fold of mucous membrane—seen at the operator's right. The first curve of the sigmoid is to the right. The sigmoid and colonic mucosa is lighter than that of the rectum.

**3. Treatment by Means of the Sigmoidoscope.**—In proctitis, ulceration, etc., topical application of silver nitrate, phenol, and other substances may be done by applicators through the sigmoidoscope with the greatest exactness.

Soper has introduced two methods of treatment by the sigmoidoscope which I have found very useful and valuable. One is the application of calomel powder to the mucosa. It is introduced by a powder blower of the de Vilbiss type with a long tube (Fig. 68, *D*). The calomel is usually mixed with bismuth as it keeps better in this way. The powder coats the entire mucosa, and resembles frosting on a cake. It is antiseptic and soothing and is applicable to ulceration, inflammation and particularly the infection of the gut wall that accompanies the constipation due to prolonged use of cathartics and particularly enemata.

Another method Soper uses is the instillation of a 50 per cent solution of magnesium sulphate. This acts as it does in the duodenal mucosa as an antispasmodic. In cases of spastic constipation and allied conditions, it works like a charm. It is instilled by means of a catheter introduced into the sigmoid through the sigmoidoscope. The instrument is then withdrawn and the magnesium sulphate solution about 20 to 50 c.c., as a dose is introduced by a syringe through the catheter. The patient is instructed to lie on the right side for half an hour before expelling the solution.

In cases of spasm of the sigmoid from any cause, this is a most effective method of treatment.

## VI. THE THERAPEUTIC USE OF ADHESIVE TAPE

The uses of adhesive tape are very numerous both in medicine and surgery. The orthopedic surgeon uses it in a large number of conditions, such as fractured clavicle and sprained ankle without other means

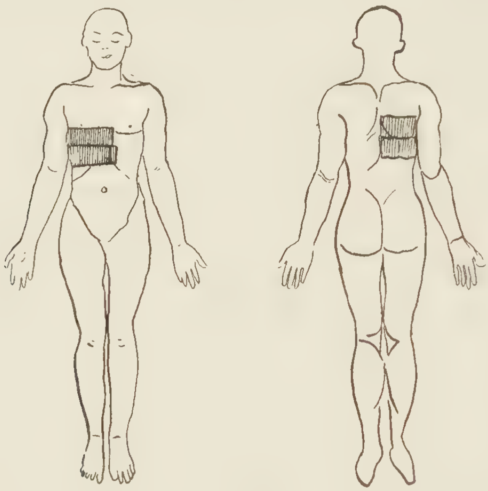


Fig. 69.—Application of adhesive strapping to chest.

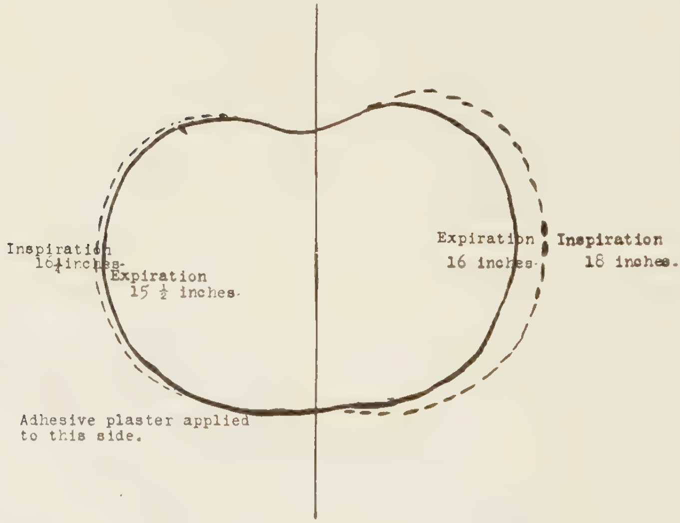



Fig. 70.—Effect of adhesive strapping properly applied in limiting the excursion of the chest wall in inspiration.

of mobilization. The obstetrician finds it useful in mastitis for support of the breast. Here we will consider a few of its uses in strictly medical cases.

1. In fibrinous pleurisy, when no fluid has formed but when the patient has considerable pain on breathing or in pneumonia with pain, or in serous pleurisy after the removal of fluid, the proper application of an immobilizing band of adhesive on the affected side may be the only

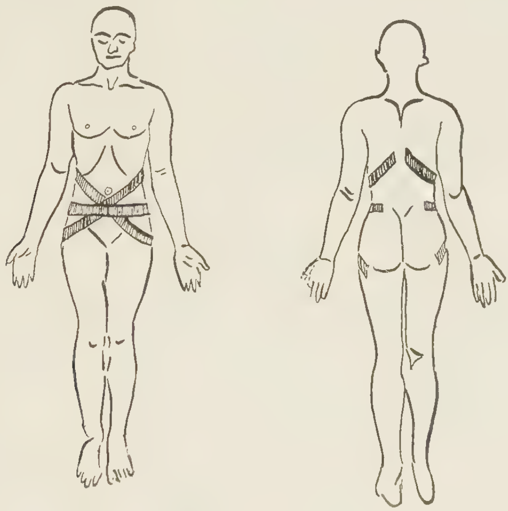


Fig. 71.—Application of adhesive plaster to abdomen in the treatment of visceroptosis (Soper's method).

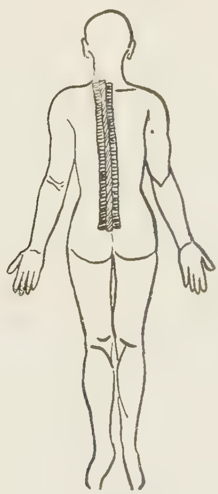


Fig. 72.—Application of adhesive plaster to spinal and lumbar muscles in lumbago.

treatment required. I have many times made measurements and have found that the reduction in the excursion of the chest wall during ordinary inspiration after the application of the adhesive, was two to three inches. It is easy to understand how such a diminution in the

irritative rubbing of two inflamed surfaces would reduce the pain of which the patient usually complains.

The technic of application, while simple, should be carried out in careful detail. A single wide strip of adhesive is usually better as it does not fold into small ridges and irritate the skin. With the patient sitting up (on a bed or examining table) the strip is fixed at the edge of the spinous processes of the vertebrae. The patient then lies down, the operator holding the strip up, and fitting it snugly half-way around the chest. The patient is instructed to exhale completely and the operator choosing the moment at the height of expiration with a very rapid motion brings the strap down over the axillary and anterior aspects of the chest. The ribs are thus mobilized at the end of complete expiration, giving the greatest amount of rest to the parts.

2. In visceroptosis, Soper has given out a method of supporting the abdominal viscera, with adhesive plaster, obviating the use of a corset. It is a modification of Rose's method, using narrower (2 inch) strips. He describes its application as follows:

"The patient sits on a couch, the adhesive strip is fastened to dorsal vertebrae and follows the right lower rib margins; the patient now lies down, the lower abdominal contents are pushed upwards with the operator's left hand while the bandage is carried across the abdomen and attached to the left side at Poupart's ligament. The patient again sits up and a second strip is applied to the other side in exactly the same way as the first one. Finally a third strip is attached across from one superior iliac spine to the other, the patient lying down. The bandage can be worn comfortably for two weeks. Bathing is not interfered with. It is easily removed by gasoline or benzine, or, as Dr. E. J. G. Beardsley has recently recommended, by oil of wintergreen. The bandage may be reapplied immediately, or in the event that irritation of the skin occurs, an interval of several days may elapse before replacing it."

3. In lumbago or painful back three adhesive strips placed in the middle and along each side of the spine, and others run around the pelvis are often of great benefit.

## VII. RESUSCITATION—ARTIFICIAL RESPIRATION

There is an astonishing lack of instruction in medical schools and a corresponding lack of knowledge among medical practitioners of the physiologic principles involved in, and the correct method of, performing artificial respiration. It is a safe venture that, if ten average otherwise learned physicians and surgeons were called upon to resuscitate ten

drowning persons, at least half of them would employ the worst methods. And yet there is available the result of splendidly conducted experiments upon this very humble feat in therapy, which should be as essential a part of every practitioner's knowledge as the knowledge of how to open a boil. No one, I believe it is a fair statement to make, should be allowed to engage in the practice of the healing art without reading Professor E. A. Schafer's Harvey Lecture for 1908 on "Artificial Respiration in Man."

Fig. 73.—Resuscitation by the prone pressure method. Top figure shows the operator producing expiration by pressing on the lower part of the thorax. The lower figure shows the operator releasing pressure on the thorax and thus allowing inspiration to occur by the natural force of elasticity of the chest. This prone pressure method has been proved to be by all odds the most effective means of performing artificial respiration. It produces the largest amount of respiratory exchange, requires only one operator, and tires him so little that the operation can be continued for an indefinite period of time. The position of the patient face down tends to prevent the obstruction of the glottis by the falling back of the tongue.

The methods best known until Dr. Schafer introduced the prone pressure method were those of Marshall Hall, Silvester, and Howard. Marshall Hall in 1857 published a paper on "Prone and Postural Method in Drowning" in which he recommended that the victim be moved alternately from a position lying on his face to a position lying on one side—from the prone to the lateral position. It was held that when the patient

was lying on his face, the thorax would be compressed, and the pressure on the abdomen would push up the diaphragm, thus producing expiration, and that when he was turned to the lateral position the natural elasticity of the chest would allow inspiration to occur.

In 1858 Dr. H. R. Silvester published in the *British Medical Journal* a paper on "The True Physiological Method of Restoring Apparently Drowned or Dead." By this method the subject is placed upon his back and the arms forcibly raised over the head, pulling the thorax out laterally to produce inspiration and bringing the arms down and compressing the abdomen to produce expiration. It is at once the best known, most frequently employed, and worst method of performing artificial respiration.

The Howard method, published in 1869 in New York as "Plain Rules for the Restoration of Persons Apparently Dead from Drowning," consists in placing the patient face down and pressing with all the operator's weight two or three times on the back in order to squeeze all the water out of the stomach and lungs, then turning the patient on the back and kneeling across his legs to grasp the lower part of the chest and squeeze the two sides together for a few seconds, then suddenly to release the pressure and allow the chest to expand by its own elasticity.

The disadvantage which both the Howard and Silvester methods have is that the patient is laid on his back, in which position the tongue may fall backwards closing the glottis.

In 1890 the Royal Medical and Chirurgical Society of London appointed a committee to investigate the relative efficiency of the various methods of performing artificial respiration. Fortunately, of this committee Professor Schafer was made a member. He conducted a number of experiments on the cadaver, on animals and on living human subjects to determine the physiology of drowning and the method of resuscitation which produced the largest amount of respiratory exchange. He was forced to invent a new method, the prone pressure method, which has since been adopted as the official method of resuscitation by the Royal Life Saving Society in Great Britian, by the American Gas Company's Resuscitation Committee, and the National Electric Light Association in the United States.

The prone pressure method of artificial respiration is very simple. The patient is laid face downward The arms are extended upward. One arm is bent so that the forehead can rest upon it, thus raising the nose and mouth from the ground and allowing air to move in and out freely. The operator, in a kneeling position, straddles the patient's legs and alternately makes pressure by placing his hands on the lower part of the thorax on both sides, pressing downward with his weight, and

then suddenly sitting back and releasing pressure. When the pressure is released the natural elasticity of the thorax allows it to expand.

There are three advantages to the prone pressure method: First, it produces by far the largest amount of respiratory exchange. Professor Schafer's committee arrived at the following conclusions concerning the various methods:

| MODE OF RESPIRATION | RESPIRATION PER MINUTE | AIR EXCHANGE PER RESPIRATION | AIR EXCHANGE PER MINUTE |
|---|---|---|---|
| Natural | 13 | 450 c.c. | 5850 c.c. |
| Silvester | 13 | 175 c.c. | 2280 c.c. |
| Howard | 13 | 310 c.c. | 4030 c.c. |
| Marshall Hall | 13 | 254 c.c. | 3300 c.c. |
| Prone Pressure | 13 | 520 c.c. | 6760 c.c. |

Second, the patient being face downward the tongue tends to fall forward and the possibility of obstructing the glottis is minimized. In methods in which the patient is placed on the back, the tongue must often be held forward, and usually this must be done with instruments which at the time of accidents are not always available.

Third, the method can be performed by the operator almost indefinitely without fatigue. This is a very important advantage because every one experienced in emergency work agrees that many persons who seem certainly dead may be resuscitated in the most astonishing way by perseverance and long continuance of artificial respiration. Finally, it is simple, can be performed anywhere by one person without assistance, needs no apparatus, is probably superior to all instrumental methods. No committee which has reported, of which I am aware, prefers any artificial respiration apparatus.

Artificial respiration by the prone pressure method is the most important therapeutic procedure in drowning, electrical shock, and carbon monoxide poison.

In drowning, experiments indicate that neither the amount of water inhaled nor the length of time of immersion determines the time onset or depth of asphyxia. In a small dog 385 c.c. of water were inhaled at the time death occurred, and in a larger collie only 75 c.c. Nor does the water accumulate in the lung; it is quickly absorbed into the blood from the alveoli. Thus for a person who has been only a short time under water, the operator need not expect to have a large amount of water pumped out. When drowned bodies remain in the water several days, of course the lungs are saturated. The reflex action of the water on the lungs and skin seems to cause respiratory failure and cardiac failure with a great fall of blood pressure preceding the cardiac failure.

One of the most important findings of the Royal London committee was the necessity for prompt action. Respiration is the main thing and

should be begun at once. Do not stop to loosen the neck band or remove corsets. "Dry ground, warmth, stimulants are of secondary importance. * * * Before natural breathing is restored do not let the patient lie on his back, unless some person holds the tongue forward."

In electrical shock a current which passes from foot to foot seldom does any damage. A current from arm to arm is the dangerous sort. Dry contacts make less danger than wet ones. Small voltage causes fibrillation of the heart, high voltage paralysis of the respiratory center. The first duty of the resuscitator is to clear the victim from the current, care being taken to avoid receiving a shock. Any dry nonconductor (rubber gloves, clothing, wood or rope) may be used to move either the victim or the conductor. Metal or moist material should not be used. If both the victim's hands are grasping live conductors they should be freed one at a time. If necessary the current should be shut off. If it is necessary to cut a live wire, an ax or hatchet with a dry wooden handle should be used, turning the face away to protect from an electric flash. As artificial respiration is begun, the victim's mouth cavity should be explored to find false teeth, chewing gum, tobacco, etc. If the mouth is shut tight do not waste time trying to open it. Every moment of delay is serious. "Nothing less than the cooling of the body or the onset of rigor mortis should be taken as evidence of death here." Resuscitation should continue, if necessary, four hours. Cases are on record of success after three and a half hours' work.

Carbon monoxide poisoning is considered under the chapter on intoxications.

## References

### *Transfusion*

**Ashby:** The Determination of the Length of Life of Transfused Blood Corpuscles, Jour. Exper. Med., March 1, 1919, xxix, 267-268.

**Drinker and Brittingham:** Transfusion Reactions, Arch. Inter. Med., February, 1919, xxiii, 133.

**Landsteiner:** Wein. klin. Wchnschr., November, 1901, xiv.

**Lindeman:** Blood Transfusion by the Syringe-Cannula System, Jour. Am. Med. Assn., Oct. 31, 1914, lxiii, No. 18.

**Moss, W. L.:** Bull. Johns Hopkins Hosp., March, 1910, xxi.

**Ottenberg and Libman:** Blood Transfusion, Am. Jour. Med. Sc., July, 1915, cl, 36-69.

**Pemberton:** Blood Transfusion, Surg., Gynec. and Obst., xxvii, 262-276, March, 1919, xxvii, 262-276.

**Sanford:** Jour. Am. Med. Assn., Sept. 9, 1916, lxvii, 808.

**Unger:** The Deleterious Effect of Sodium Citrate Employed in Blood Transfusion, Jour. Am. Med. Assn., Dec. 31, 1921, lxxvii, No. 27.

**Unger:** A New Method of Syringe Transfusion, Jour. Am. Med. Assn., Feb. 13, 1915, lxiv, 582.

### *Lumbar Puncture*

**Dandy, W. E.:** Diagnosis and Treatment of Hydrocephalus Due to Occlusions of the Foramina of Magendie and Luschka, Surg., Gynec. and Obst., February, 1921, xxxii, No. 2.

Dandy, W. E.: Experimental Hydrocephalus, Ann. Surg., August, 1919.
Frazier: The Cerebrospinal Fluid in Health and Disease, Jour. Am. Med. Assn., April 3, 1915, lxiv, No. 14.
An interesting review of the experimental evidence which forms the basis of our ideas of the physiology of cerebrospinal fluid.
Goldman: Arch. f. klin Chir., 1913, ci, No. 3.
Kaliski: Tice's Practice of Medicine, i, 475. A good introduction to the whole subject of cerebrospinal fluid and lumbar puncture.
Lusk: The Anatomy of Spinal Puncture, Ann. Surg., October, 1911.

### *Thoracentesis*

Lord: Air Tight Trocar for Thoracentesis, Jour. Am. Med. Assn., 1908.
Capps: An Experimental Study of the Pain Sense in the Pleural Membranes, Arch. Inter. Med., 1911, viii, 717.

### *Artificial Pneumothorax*

Brauer: Munch. med. Wchnschr., 1906, liii, 337.
Forlanini, C.: Gazetta degli Ospedali, 1882.
Morelli, Juan B.: Pneumothorax Artificial. Two volumes. Montivideo; Imprenta Nacional, 1918.
Murphy, J. B.: Jour. Am. Med. Assn., 1898, xxxi, 151.
Peters, LeRoy S.: New York Med. Jour., March and April, 1919.
Ringer: An Analysis of 30 Cases of Pulmonary Tuberculosis Treated by Artificial Pneumothorax, Am. Jour. Med. Sc., 1917, cliv, No. 3, p. 380.
Riviere, Clive: The Pneumothorax Treatment of Pulmonary Tuberculosis. London Oxford University Press, 1917.
Robinson and Floyd: Arch. Inter. Med., 1912, ix, 452.
Sachs: Jour. Am. Med. Assn., 1915, lxv, 1861.
Webb, Gilbert, James, and Havens: Arch. Inter. Med., 1914, xiv, 883.
Weil: Bull. de'l' acad. de Med., 1919, lxxxi, 864.

### *Gastric Lavage, etc.*

Bassler: Diseases of the Stomach and Upper Alimentary Tract, F. A. Davis Co.
Lyon: Jour. Am. Med. Assn., Sept. 27, 1919, lxxiii, 980-982.

### *Therapeutic Uses of Adhesive*

Soper, H. W.: The Treatment of Gastroptosis, Jour. Missouri State Med. Assn., January, 1912.

### *Resuscitation*

McClachlan: Resuscitation after Electrical Shock, Jour. Am. Med. Assn., September 6, 1924, lxxxiii, No. 10.
Henderson: Resuscitation from Carbon Monoxide Asphyxia, Jour. Am. Med. Assn., September 6, 1924, lxxxiii, No. 10.
Schafer: Harvey Lecture, 1908.

# PART II

# SPECIAL THERAPEUTICS

# THE APPLICATION OF THERAPEUTICS TO PARTICULAR DISEASES

## CHAPTER XIV

## THE TREATMENT OF THE INFECTIOUS DISEASES*

### I. GENERAL PRINCIPLES OF THE TREATMENT OF THE INFECTIOUS DISEASES

Whether or not we have a specific method of treatment for an infectious disease, there are certain general methods of treatment which must be carried out. Their success depends upon scrupulous attention to detail. Many of them are better known to trained nurses than to physicians, and physicians are not sufficiently trained or instructed in their performance. In fact, textbooks on medicine are very remiss in the emphasis placed on these things. And yet upon their exact accomplishment depends much of the safety of the patient, and all of his comfort. Because only a small proportion of the population can have the benefit of a trained nurse and because, therefore, the attending physician must be able to instruct the family meticulously in these matters, they are set down here in a separate place. They apply, however, to all the acute infectious diseases.

#### 1. Rest in Bed

*The bed* in an acute infectious disease may be already selected by the fact that the patient is in it, but if a long period of illness is to be anticipated, as is the case in typhoid fever, a readjustment of the bed and bedding should be made. The ideal bed is the half or three-quarters bed. The mattress should be 30 inches from the floor. The modern hospital bed is about 36 inches from the floor but this high a bed is difficult to find in a household. For the benefit and comfort of the attendant—whether nurse or member of the family—the high bed is very important. The lifting of the patient, bathing, placing and withdrawal of bed pans, etc., are all facilitated.

*Tropical diseases are not considered in this book.

The springs should be strong and the mattress firm and resilient. A blanket should be spread over the mattress to make it smooth. Over the blanket is placed a sheet, a rubber sheet, or strip of linoleum and a draw sheet. The sheets should be pulled taut and firmly tucked in. A well-made bed is a very important factor in the patient's comfort, and for patients who are lethargic or sick for a long time, in the prevention of bedsores.

Over the patient a smooth sheet and light blanket are usually sufficient.

*The room* should be the largest available. The most important factors are light, air and accessibility to the bath room. In cold months a sunshiny room, in warm months a shady room. In the case of a pneumonia patient a sleeping porch or balcony opening onto a bedroom is desirable particularly if the bed has large enough castors to wheel it off and on the porch as the weather changes, or for changing the bed clothes or using the bed pan. The room of the sick should always be screened, to protect from insects in the summer and dust in the winter.

The temperature of the room should be about 65° to 70° F. unless open air methods are desired.

In the case of contagious diseases the room selected should be off the main line of travel in the household—a room on the third floor preferably if a bathroom is available. The furniture should be such as can be destroyed or painted after the illness is over. No hangings, window curtains or pictures should be left up unless they can be burned after convalescence. For a child the books and toys should be selected with a view to their subsequent destruction.

### 2. Disinfection

Stools should be covered with $\frac{1}{20}$ phenol or $\frac{1}{50}$ lysol. This is especially important in the case of typhoid fever. The stool should be broken up and thoroughly soaked before being emptied into the toilet.

The urine may be disinfected by the use of $\frac{1}{20}$ phenol or lysol as with the stools, one-third part of the disinfectant to the volume of urine. One to one-thousand bichloride solution, $\frac{1}{15}$ of the volume of the urine, standing for an hour, also is valuable.

**Bath water** should be disinfected by the addition of $\frac{1}{2}$ pound of chlorinated lime to a tub of water.

**Bed linen** should be soaked in a wash tub of water with 3 ounces of formalin to the gallon. It may also be boiled in a wash boiler.

**Mattresses** present a hard problem. Sunshine and repeated airings are perhaps as effective as anything. Under certain circumstances, i.e., scarlet fever or smallpox, the mattress should be burned irrespective of economic considerations.

**Bed pans, urinals, enema tips, etc.**, should be soaked in $\frac{1}{50}$ lysol solution after use.

**Knives, forks, spoons and dishes** should be separated and boiled daily.

### 3. Care of the Patient's Body

Often in contagious or infectious disease the patient is comatose or at least indifferent to the niceties of comfort. The attendant must prevent complications and decrease absorption of decomposition products by careful attention to detail in the cleansing of the patient's skin, eyes, ears, nose and mouth.

**Skin.**—A cleansing sponge bath should be given daily. If a nurse is in attendance she will see to this, but it is not always safe to take matters for granted and a few inquiries should always be made in order to confirm the fact that these matters are being properly carried out. The temperature of the room must be temporarily raised to 75° F. or 80° F. while the bath is being given. At the beginning of the bath the water should be at a temperature of 100° F. in the basin. As it cools the effect of the tepid water is beneficial to the temperature and vasomotor system. Castile soap of the purest kind only should be used. It is a matter of great importance that the skin should be thoroughly dried, especially on the back, buttocks and shoulders in order to prevent the development of bedsores. If the buttocks have been soiled, an extra rubbing with alcohol, and dusting with talcum powder after the bath is an extra precaution against bedsores. The skin of the back can be dusted with talcum powder if this is grateful to the patient.

When bedsores actually threaten, the patient's position should be frequently changed and rubber rings used. Aristol or a zinc oxide ointment should be used on the skin which is threatened and all pressure removed from it.

**The Eyes.**—In many infections, particularly measles, the conjunctivae are distinctly reddened and the eyes must be protected by darkening the room, or wearing dark glasses. Secretions from the eyes should be wiped away; the patient may be too sick or indifferent to do it. They may have to be softened by applying a wet piece of gauze over them before being removed. The eyes, under such circumstances, should be irrigated with a saturated solution of boric acid.

**The ears** should be watched although no particular preventative treatment need be directed towards them.

**The nose** needs very particular attention daily. If the nose is occluded with secretions the patient must breathe through the mouth which be-

comes dry and uncomfortable. Dried secretions should be softened with vaseline. A swab—a piece of cotton on the end of an applicator—is thrust into each nostril to clear it. A spray of one of the bland, oily mixtures containing menthol, camphor, oil of eucalyptus, oil of pine or oil of turpentine will usually be found grateful and helpful.

**The mouth** must be kept scrupulously clean. The patient must brush the teeth with a good brush and tooth paste, or powder, and rinse the mouth thoroughly. If the patient is too weak or stuporous to do this, the nurse or attendant must attempt it. In either case the interstices of the teeth and gums should be swabbed out with a pledget of cotton, on an applicator, in order to remove pus or decomposing particles of food. After every meal the mouth should be rinsed; and before going to sleep an antiseptic mouth wash, such as the liquor antisepticus or liquor antisepticus alkalinis of the National Formulary used.

**The tongue** must be kept moist if possible. Often extreme drying and cracking seem to be inevitable. Plenty of water internally helps the tongue as well as every other part of the body. Cracked ice kept in the mouth does much to help. If a heavy coating occurs on the tongue, it must be scraped away with a tongue depressor or whalebone. After this half-strength peroxide of hydrogen should be applied to the tongue. Glycerin and lemon juice is a helpful mixture to apply to the tongue, gums and lips.

**Fissures, sores and herpes around the lips, mouth and nose** should be cleaned and kept soft with vaseline or camphorated oil or camphorated vaseline.

**The genitals** often have to receive careful treatment. Excoriation may occur when the feces or urine is of a burning character. The buttocks and in the female the vulvae should be thoroughly cleaned after defecation and urination. An external douche under certain circumstances may conveniently be given while the patient is still on the bed pan. A dusting powder should always follow, particularly if the genitals have a tendency to moisture.

## 4. Diet

**Water** intake cannot always be left to the patient's discretion or desires. Studies of certain infections, such as pneumonia, have shown that water is utilized in large amounts, and that the intake may advantageously be put at 1500 to 3000 c.c. A thermos bottle and glass, or a full glass of water should always be at the patient's bedside. The attendant should see that the patient has a good drink at least every hour.

**Food.**—The question of diet in fever is discussed in the chapter on diet. To restate the problem briefly, there is no doubt that in fever there is an increased protein destruction and generally higher caloric waste, so that the actual food requirements of the body are higher. To demonstrate this, it is known that after most fevers there is an appreciable loss of body weight. On the other hand there is in fever a decreased desire for food, and probably decreased ability to digest it (though this is often exaggerated). In fevers of short duration the problem is unimportant, but in long continued fevers the best therapy aims to provide full caloric and protein requirements in the form of easily digested food.

Simple bland foods and food preparations are numerous and easily prepared. Some special recipes are given in the chapter on diet. Milk and eggs are old standbys. Milk, toast, junket, ice cream, bouillon, soups, coddled eggs, etc., should be particularly specified in fevers.

### 5. Hydrotherapy

Water externally is of great value in infectious diseases. The temperature bath, the sponge bath and the slush help in maintaining the tone of the heart and arteries, stimulate the kidneys and aid in the elimination of toxins. They are sedatives to overalert nervous systems and induce rest and sleep. In case of impending cardiovascular failure the sponge bath or the wet pack is very useful. They are described in detail in the chapter on Hydrotherapy.

### 6. Fresh Air

The sick room must be well ventilated, and the air must be freely moving—1000 cubic feet of air to every bed is essential in cases of infectious disease, and in pneumonia it should be doubled. Open air in some conditions is of great value; even a necessity. It has qualities which cannot be approached with the air of a room. The freedom of movement of the air increases combustion and the rapid respiratory exchange improves the appetite, raises blood pressure, and induces restfulness and sleep.

### 7. Symptomatic Treatment

**The Bowels.**—It is a long-established practice to open the bowels as a preliminary to all treatment of an acute infection, provided it is not localized in the abdomen. The intestinal musculature is sluggish as are all other muscles in fever and needs stimulation. Calomel followed by magnesium citrate is my own favorite method of catharsis, selected because it is both effective in action and pleasant for administration.

**Tympanites** may need attention. It may be due to excessive starch in the diet, especially lactose in milk. If correction of diet will not cause its disappearance, one of the following measures may be employed:

*a. The colon tube* inserted in the rectum. A soft pliable catheter will serve. It should be inserted to the length of 12-15 inches. Force should never be used in the introduction. It should be left in for half an hour and the patient rolled from side to side to facilitate the escape of gas.

*b. Stupes.*—A plain stupe or a turpentine stupe. The abdomen should be covered with vaseline, a flannel roller put under the patient, the stupe put on the abdomen, and the flannel roller brought up to cover the stupe. A dram of turpentine added to the hot water in which the flannel rags are wrung out, will convert a plain stupe into a turpentine stupe.

*c. Enema.*—A soapsuds enema or turpentine enema (one-half to one ounce of turpentine to a pint of hot water soapsuds).

*d. Oil of Peppermint* (4 or 5 minims on sugar) or oil of turpentine (10 minims in capsule) by mouth.

*e. Hypodermic of eserin salicylate,* $\frac{1}{50}$ grain (0.001 gm.).

**The Febrile Condition.**—In general most of the infections could be treated better without the display of any routine drug. The feelings of the family, however, and the ancient taboo which is found even in modern and civilized households, and which feels subconsciously that when acute illness is present a drug exists, which accomplishes or at least hastens recovery, makes it nearly imperative for the physician to satisfy these longings. If a drug is to be given it should, at least, be perfectly harmless, and if possible should satisfy some indication. An indication is usually present in the early stages in the feeling of lassitude, the achiness of the muscles and headache. Some form of the coal tar products, aspirin, phenacetin, sodium salicylate, antipyrine or (rarely) acetanilid may be given. Worth Hale demonstrated that caffeine and sodium bicarbonate combined with acetanilid increased the effectiveness and probably also the toxicity of the acetanilid. This is true of all the coal tar products, and small doses of aspirin, phenacetin and caffeine are given usually in preference to the first two drugs alone. Given in small dosage frequently repeated this combination is calculated to make a febrile patient as comfortable as is possible. A minute dose of powdered opium or codeine may be added if pain is severe or restlessness extreme.

**Insomnia** may be treated with veronal or medinal, or if due to motor muscle restlessness, with the bromides.

**Delirium** is treated according to its severity. Restraint, morphine or in severe cases the straightjacket.

**Cardiovascular Stimulation.**—A portion of Chapter XVIII, on the cardiac failure in the acute infections should be read in this connection. In lobar pneumonia, influenza and typhoid fever following the work of Cohn, I usually use 10 to 15 minims of the tincture of digitalis three times daily as a routine, beginning at the very onset of fever. When cardiovascular failure is impending, hydrotherapy—the sponge bath, or the wet pack—seems to me the best method of treatment. When failure is actually present, caffeine intravenously or adrenalin intravenously are the most effective remedies.

**Phlebitis** may occur in the course of any of the infections. It usually occurs in the femoral vein, and the leg should be kept absolutely quiet. This is the most important element in treatment. It should be elevated on a pillow or several pillows. The pillows act as a good splint. Ichthyol painted over the skin of the entire part affected, the leg then swathed in cotton gives great relief. Massage is absolutely contraindicated and is dangerous.

### 8. Isolation, Quarantine and Prevention of Reinfection

Isolation will usually be advisable in most of the infectious diseases. The attendants upon the patient, the nurse and physician, should each wear an operating gown, a cap which entirely covers the hair and, in some instances, rubber gloves. A face mask of gauze covering the mouth and nose should be worn when attending cases of diphtheria, pneumonia, scarlet fever, influenza and any other disease in which the patient is likely to cough up or spit contagious materials. The physician should don his gown, cap and mask immediately on entering the sick room and take them off just as he leaves. Upon leaving the patient the attendant should wash the hands and face thoroughly in soap and water. These precautions are not only the merest common sense for personal safety but, on the part of the physician, are an obligation which he owes to his other patients and the public.

In hospital practice where patients with the same contagious disease are segregated in a ward, the beds should be separated from each other by a curtain made of a linen sheet. This prevents crossed infection and reinfection of patients from particles of sputum and nasal secretion blown and coughed into the air.

In private houses after the removal of the patient from the sick room the room should be aired and swept, the walls and floor washed down with soap and water followed by a rubbing with cloths, wet in a solution of $\frac{1}{2000}$ bichloride of mercury. The hangings and bed linen will be sterilized as previously indicated above. Fumigation of the room

with formaldehyde is done by stuffing up the cracks of the doors and windows with cotton, setting a pan on newspapers in the center of the floor and putting in the pan 6½ ounces of potassium permanganate and pouring over it 1 pint of formalin. This quantity will fumigate 500 cubic feet of space.

## PNEUMONIA

(Lobar and bronchopneumonia have the same treatment.)

For pneumonia the following routine orders should be written out whether in private or hospital practice:

1. Record temperature, pulse, respiration and blood pressure every four hours.
2. Record leucocyte count and urinalysis twice a week.
3. Rest in bed, sitting up if necessary.
4. Apply flannel pneumonia jacket and chest compress if grateful to patient.
5. The bowels should be opened with enema, magnesium citrate, or pills as desired or most effective.
6. A glass of water every hour.
7. Liquid diet.
8. Open air—on porch or with bedroom windows open. (If the patient is old and weak and does not respond to open air delete or modify this order.)
9. Care of skin, eyes, nose, mouth, tongue and genitals by nurse or attendant.
10. Medicine.

Tincture of digitalis 10 minims every 4 hours.

**For cough** (if troublesome) compound tincture benzoin ʒ i on pan of boiling water as inhalant.

Heroin (gr. ½), Menthol (gr. i) and Syr. Pruni. virg. (℥ iv) as cough mist. A teaspoonful to a dose.

**For Collapse.**—

1. Caffeine and sodium benzoate, gr. ¼ to ½ intravenously.
2. Glucose intravenously (100 to 500 c.c. 10 per cent solution).
3. Epinephrine chloride, 15 minims of a $\frac{1}{1000}$ solution intramuscularly or intravenously.
4. Ephedrine sulphate has the same general pharmacologic action as epinephrine and the advantage that its effect lasts over a

period of hours instead of minutes. It may be given hypodermically or by mouth. For dosage see Chapter II, Part I.

**Note.**—The technic for the above procedures will be found in other parts of this book. For the preparation of the pneumonia jacket and chest compress see Chapter on Hydrotherapy. For the care of the body (skin, eyes, mouth, etc.) see the introduction to this chapter. For the diet in infectious diseases see Chapter on Diet. For the dosage and administration of digitalis see Chapter II, Part I, on Drugs. For the discussion and treatment of collapse in the infectious diseases see Chapter XVIII, Part II, the section on Cardiac Failure.

### Comment

**1. Rest Paramount.**—The most important thing in the treatment of pneumonia is quiet and rest. It is not necessary to examine the patient every day. The pulse, temperature, respirations and blood pressure are sufficient guide to the patient's condition; it is not necessary to know the extent of the involvement of the lungs. The turning of the patient consequent upon a thorough physical examination is nearly always somewhat exhausting, and often actually highly dangerous. It only serves to satisfy a vulgar curiosity. What difference does it make if one or two lobes are involved? You do not double the dose of digitalis or camphor if two lobes are involved, instead of one.

**2. Specific Treatment for Pneumonia.**—There is no specific serum, vaccine or other biologic product which has been demonstrated to be effective, as of this date. We may hope that one will be discovered some day, and when it is, the entire profession, indeed the entire world, will know of it immediately.

**3. Symptomatic Treatment of Pneumonia.**—The best we can do in the presence of pneumonia is to treat it symptomatically, that is, combat the tendencies in the body, which result from the general metabolism of the infection and which, if allowed to continue, will result in death. I say "allowed to continue" but this is boastful. Our means of combating them are pitifully inadequate.

*Anoxemia.*—The anatomical conditions in pneumonia would tend to induce a reduction in oxygenation. The use of oxygen in pneumonia has been given widespread trial, and the general opinion of the profession has been unfavorable. It is likely that this opinion needs revision. The use of oxygen in the light of modern opinion is discussed in Chapter XV.

*Acidosis.*—The hyperpnea of pneumonia may be an expression of acidosis. When blood alkali is used up by neutralizing acid, the carbon dioxide

tension of the blood must be reduced in order to preserve blood reaction at its normal point. This is done by reducing the alveolar carbon dioxide tension by increased aeration. Means and Barach by studying a series of pneumonia patients and plotting the carbon dioxide diagram of the blood were convinced that the administration of alkalies by mouth is very necessary in pneumonia. Other observers, however, are not in entire agreement. If alkali therapy is initiated in pneumonia, it should be done only upon definite indications based on laboratory tests.

*Chloride Suppression.*—It is well known that in lobar pneumonia there is a complete suppression of chlorides in the urine. This may mean that there is a vastly increased need of chlorides in the metabolism of the pneumonic patient. Therapy by supplying salt solution intravenously and per rectum has a justifiable basis for extensive study. While no large number of pneumonia patients has been studied in this way, I have been using the method as a routine in some cases with encouraging results.

**4. Other Methods.**—Many other methods have been used and proposed for the treatment of pneumonia. Solis-Cohen has advocated the use of *quinine.* He believes the action to be semispecific. He uses the dihydrobromid of quinine by mouth, 25 to 35 grains to begin with, and 5 to 15 grains every two, three or four hours. For intramuscular injection he uses quinine and urea hydrochlorid, 15 grains as soon as the patient is seen and repeated every third hour until the temperature remains below 102° F. consistently. He uses hypophysis extract and digitalis along with the quinine.

*Camphor* was once supposed to be a specific antagonist for the pneumococcus. It may be given in the form of camphorated oil or in an emulsion made up as follows:

℞
Camphorated oil 10%
Acacia pulv. 12 gm.
Aqua. dest. q.s. ad. 500 c.c.
Dose: teaspoonful.

*Venesection* should not be disregarded.

*Cupping* is often of great relief. The technic is as follows:

The skin over the area to be cupped should be cleansed and dried. The cups to be used should be made of rather thin glass so that they will not fall off by their own weight. A vacuum is created inside the cup, usually by smearing the inside with a thin film of alcohol and lighting it, applying the cup while it is still aflame. Care should be taken not to have an excess of alcohol which might run down the patient's skin and cause a severe burn.

## INFLUENZA

**Routine Orders.—**

1. Record pulse, temperature, respiration and blood pressure every 4 hours.
2. Rest in bed.
3. Apply flannel pneumonia jacket to chest.
4. The bowels should be opened with enema, magnesium citrate, or pills as desired or most effective.
5. A glass of water every hour.
6. Liquid diet.
7. Open air—on porch or with bedroom windows open.
8. Care of skin, eyes, nose, mouth, tongue and genitals by nurse or attendant.
9. Coal tar products—acetanilid, acetphenetidine, etc.

There is no specific treatment.

## ERYSIPELAS

1. **Isolation.**—The question of isolation will immediately arise. The patient should be rigidly isolated and every precaution taken by the attendants to prevent contact. There is no doubt that erysipelas is contagious by direct contact, although the occurrence is rare. I have seen a woman and then her husband take down within a week of each other with facial erysipelas.

2. **Rest in Bed.**

3. **Preliminary Catharsis.**

4. **The Care of the Skin, Eyes, Mouth, Nose, Ears, etc.**, is important, but often interfered with by the inflammation and painful swelling of the face.

5. **Focal Infection.**—Local applications to the area affected are grateful and valuable. Cloths wrung out of a saturated solution of magnesium sulphate, placed on the affected area stop pain and allay inflammation.

Ichthyol used in 25 or 50 per cent ointment or painted on pure, covered with gauze is also useful.

Collodion painted on the skin on the area outside of the erysipilatous area is supposed to limit the advance of the process. It produces a depression of the layers of the skin.

6. **Medication.**—Tincture of ferric chloride given from the onset and continued through the course of the disease is the medication which long usage has established.

7. **Erysipelas Antitoxin** (10 c.c. intramuscularly) appears to reduce the period of acute illness. Mortality is not much affected by its use.

## ACUTE ARTICULAR RHEUMATISM

1. **Rest in Bed.**

2. **Isolation is not necessary.**

3. **The Room** should be airy, but drafts should be avoided because they increase pain.

4. **Local Treatment of Affected Joints.**—The joints should be mobilized. Splints improvised from cardboard or pieces of wood which can be found in the household and covered with cotton are as good as any. Resting the joint upon a pillow is a good form of mobilization. This is especially good for the leg as the weight of the limb carries it into the pillow which surrounds and splints it.

Heat to the affected joint either by hot water bag, electric pad or electric light cabinet.

Application of oil of wintergreen on flannel wrapped around the joint is a favorite old-fashioned method of considerable usefulness.

5. **Preliminary Catharsis.**

6. **Push Water and Maintain a Light Diet.**—If the disease lasts more than a week, careful preparation should be made to supply 3000 calories in the diet. No particular article of diet need be excluded in spite of any superstitions which may exist in the household as to the relation of rheumatism to diet.

7. **Care of the Mouth, Eyes, Ears, Skin as in Other Infectious Diseases.**

8. **Specific Treatment.**—The use of the salicylates is so nearly specific in acute articular rheumatism that we may consider them in that light. For full discussion of technic of administration of the salicylates, see page 63.

For routine use sodium salicylate, grains 20 (grams 1.3) every 2 hours combined with equal amounts of sodium bicarbonate. Continue this for 48 hours, then reduce to 10 grains continuing for a week or more.

Watch for toxic symptoms:

1. Roaring in the ears, or deafness.
2. Gastric disturbances.
3. Dyspnea.
4. Cerebral disturbances up to delirium.
5. Albuminuria and hematuria.
6. Hemorrhages—retinal; epistaxis.
7. Skin rashes.

If sodium salicylate is not well borne by mouth, give it intravenously, 15 grains in 10 c.c. of water at 8 or 12 hour intervals.

Substitutes for sodium salicylate:

Aspirin: dose 15 gr. every 2 hours.
Salol: gr. 2 every 2 hours.
Salicin: gr. 15 every 2 hours.
Diplosal: gr. 15 every 2 hours.
Methyl salicylate: 10 minims in a capsule every 2 hours.

**9. Nonspecific Treatment.**—In cases of articular rheumatism which do not respond to the use of salicylates, it may be suspected that you are not dealing with true articular rheumatism but acute infectious arthritis. This does not respond to the use of the salicylates. The use of nonspecific proteins—typhoid bacillus intravenously, etc., may be substituted. For full discussion see chapter on biologic therapy in Part I.

**10. Complications.**—The heart and urine should be watched daily.

**11. Removal of Foci of Infection.**—After convalescence the tonsils should be carefully inspected and removed provided they show evidence of infection. St. Lawrence has investigated the effect of tonsillectomy in 85 children who had rheumatic manifestations. They were observed over a period of three and a half years after operation. One or more attacks of acute rheumatic fever had occurred in 42 cases before the tonsils were removed. After tonsillectomy there was no recurrence in 35 of these or 84 per cent.

## TYPHOID FEVER

**1. Rest in Bed.**—a. *Bed* should be a half bed 30 inches in height. There should be strong wire springs, a firm mattress, and a blanket over the mattress to render it smooth. Over the blanket there should be a sheet, a rubber sheet, and a draw sheet. Over the patient there should be a sheet and a light blanket.

b. *The Room.*—All typhoid patients should be isolated, although contagion is rare. The room should have sunshine in cool months and shade in warm months. It should be screened against flies.

c. *Visitors* should be excluded.

**2. Nursing.**—Recovery from typhoid fever depends more upon nursing than upon doctoring. Wherever possible the patient should have a trained nurse and should be in a hospital.

**3. The Care of the Skin, Eyes, Nose, Mouth, Tongue, Teeth, Genitals,** is more important in typhoid fever than in any other disease. Scrupulous attention to the prevention of bedsores, dry tongue, conjunctivitis and

so forth cannot be too much emphasized. The methods to be used are described in detail in the introductory section to this chapter.

4. **Disinfection** of the stools, urine, bath water, bed linen, bed pans, urinals, knives, forks, spoons, sputum, vomitus, is of paramount importance.

5. **Precautions for Doctors and Nurses.**—Doctors and nurses treating typhoid fever should use all the precautions against infection described in the introductory section of this chapter.

6. **Diet.**—a. *Water* should be given to the patient hourly, whether asked for or not.

b. *Food.*—Consult the section on diet in infectious diseases, and the section on typhoid diet in the chapter on diet in Part I. The diet in typhoid fever requires skill, information and intelligent management. The patient will be sick for a long time, possibly with digestive disturbances and intolerance to food, and will at the same time require as much nourishment as he can take. No hard and fast rule can be observed. Physicians should aim at 18 calories per pound or on the average of 2500 a day. Proteins should reach 70 to 90 grams. Carbohydrates are the mainstay and the shelterers of the protein. Milk is the basis of all typhoid diets. The patient should have at least one or two quarts a day. Average milk should have a value of 160 calories to a glass of 8 ounces. Adding cream and lactose to the milk will raise the caloric value, thus:

One glass of milk of 7 ounces equals 140 calories.

Cream one ounce equals 50 calories.

Lactose ½ ounce equals 60 calories.

Total 8 ounces of milk, cream and lactose equals 250 calories.

Eggs, oatmeal, toast, butter, mashed potatoes, custards, junket, buttermilk, orange juice, apple sauce and ice cream can all be given to the typhoid patient. In convalescence, chicken, jellies and scraped beef.

7. **Baths.**—The Brand bath or a substitute should be administered daily, as needed. For technic, see chapter on Hydrotherapy, Part I.

8. **Care of the Alimentary Canal.**—

a. *Initial catharsis:* castor oil or salts or calomel.

b. *When the case is seen late:*

Enema of tepid water.

Soapsuds enema. (Use castile soap.)

Oil enema. Make thick suds of castile soap and warm water, stir in olive oil slowly with water to make two pints.

9. **Routine Medication.**—No routine medication in typhoid fever can be recommended. A mild intestinal antiseptic, such as salol, grains 5,

every 4 to 6 hours, will meet the requirements of keeping the bowel free from gas and satisfying the family.

Nonspecific protein therapy, using typhoid bacilli has been recommended. For discussion, see chapter on biologic therapy, Part I.

**10. Complications.**—a. *Tympanites.*—Suspect milk sugar and reduce it. Reduce all carbohydrates in diet. Use stupes and turpentine stupes (for technic see introductory section to this chapter under the head of tympanites).

b. *Diarrhea.*—Suspect fat and reduce it. Milk may have to be stopped.

c. *Hemorrhage.*—Use morphine immediately. It reduces peristalsis and hence tends to induce clotting. Stop food. Place ice bag on abdomen. Use serum, thromboplastin, or transfusion if necessary.

d. *Perforation.*—It is extremely important for the attendant to know the initial symptom of perforation. The nurse should be instructed to be on guard for it. The symptom is sudden sharp excruciating abdominal pain which lasts a short time, as much as half an hour and then subsides. Rigidity, tenderness, distention, and the symptoms of peritonitis come later. Only those cases are saved which have the earliest possible surgical intervention.

**11. Convalescence.**—The diet may be increased, particularly using gelatine. The use of mild cathartics is usually necessary. Anemia, if present, should be treated by iron tonics.

**12. Prevention of Typhoid Fever.**—Public prevention: Water supply, milk supply, disposal of sewage.

Treatment of carriers. This sometimes presents a difficult problem. The gall bladder and appendix may have to be removed. Vaccines may be used. X-ray over the abdomen has been tried.

Individual prophylaxis: Antityphoid vaccination has been described in detail in Chapter III on Biologic Therapy in Part I.

## TETANUS

The prevention of tetanus by antitoxin is considered in Chapter III.

The treatment of established tetanus is not satisfactory; the mortality reported by the British War Office showed 2152 soldiers who developed tetanus during the World War with 1011 deaths or 47 per cent. This is a very favorable set of statistics, including as it must many very mild cases. The usually reported mortality is near 70 per cent.

The indications for therapy in tetanus are four:

1. To remove the source of the toxin.
2. To neutralize the toxin already formed.
3. To depress the function of the spinal cord.
4. To make the patient comfortable.

1. Under the first heading the wound should be opened widely, continuously drained, and cauterized with alcoholic solution, carbolic solutions and hydrogen peroxide.

2. **Specific Treatment.**—The only possible way to give *tetanus antitoxin* in established tetanus is intraspinally. It should be given, according to Park and Nicoll, in the initial dose of 3000-5000 units in the spinal space, and repeated in 24 hours. Ten to fifteen thousand units should be given at the same time intravenously, and three or four days later a subcutaneous injection of from 10,000 to 15,000 units.

3. **Depressants.**—Magnesium sulphate solution used intraspinally was proposed by Blake and enthusiastically advocated by Meltzer as a general depressant to the spinal cord and nervous system. The solution used is a 25 per cent solution, 1 c.c. of the solution given for every 20 pounds of the patient's body weight. Meltzer states that the relaxation occurs immediately, and lasts for 24 hours. When stiffness and convulsive seizures return, the injection should be made again with somewhat smaller dosage. It does not preclude the use of antitetanic serum simultaneously.

Morphine, hyoscine and even chloroform narcosis may be needed in the distressing forms of convulsion.

## EPIDEMIC MENINGITIS

1. **Rest in Bed.**

2. **Attention to the eyes, ears, mouth, tongue, skin and genitals.** This must be more than perfunctory in meningitis because the patient is often stuporous; in the case of the skin bedsores are common.

3. **Symptomatic Treatment.**—If the patient is delirious or excited, morphine or even hyoscine can be used. The use of chloroform is seldom necessary.

4. **Specific Treatment.**—The technic of the use of antimeningococcic serum is considered in detail in the chapter on biologic therapy in Part I.

The intraspinal administration of the serum should be begun at the earliest moment possible. If organisms are demonstrated in the blood on blood culture, it should be given intravenously also. If improvement does not occur soon after intraspinal treatment, suspect the potency of the serum used and change to the serum of a different manufacturer.

In certain cases, in spite of the fact that the serum is potent, improvement does not take place because infection has become encysted in the upper parts of the central nervous system. The ventricles of the brain may be filled with pus, while the foramina and cisternae are blocked by

a gummy exudate which prevents the serum from getting into contact with the organisms in the ventricle. It is to be remembered that the serum owes its effectiveness to its bactericidal powers and that in order to be effective it must come into direct contact with the organisms. When the amount of spinal fluid obtained is smaller than the operator should obtain, when the flow seems to be obstructed or when the fluid is very thick and improvement is not taking place, *introduction of serum into the ventricles of the brain, or into the cisterna magna should be employed.*

Cushing and Sladen appear to be the first who did intraventricular tapping. In infants the needle can be introduced through the skull into the ventricle along a suture line at the external angle of the anterior fontanelle, about 2.5 cm. from the median line, the needle passing downward and inward for 2-4 cm. Usually 30-60 c.c. of fluid can be removed and replaced by an equal or smaller amount of serum. In older children and in adults, trephining is necessary at the point of the skull where the needle is to be introduced. Dopter recommends one of three points—the superior, 3 cm. in front of the bregma and 2.5 to 3 cm. away from the median line being preferred. The trephine opening need be only as large as a penny piece, just about as much bone as will come away from the revolution of a trephine burr.

The technic of cistern puncture is thus described by Ayer:

"The patient is placed on the side, as if for lumbar puncture, with the neck moderately flexed. Care is taken to maintain the alignment of the vertebral column to prevent scoliosis and torsion, and in cases in which comparative pressure readings are important the lumbar and cisterna needle should be on the same horizontal plane. After antiseptic preparation of the skin, usually including the shaving of a little hair and local anesthetization with procaine, the thumb of the left hand is placed on the spine of the axis and the needle inserted in the midline just above the thumb. The needle may be pushed rapidly through the skin, but should then be cautiously and guardedly forced forward and upward in line with the external auditory meatus and glabella, until the dura is pierced.

"If the cisterna be entered at this angle there is usually a distance of from 2.5 to 3 cm. between the dura and the medulla, as shown on frozen sections: with the needle less oblique in position the distance between the walls of the cisterna becomes progressively less. Therefore it is good practice to aim a little higher than the auditory meatus, and if the needle strikes the occiput, to depress just enough to pass the dura at its uppermost attachment to the foramen magnum. At its entrance the same sudden 'give' is felt as in lumbar puncture.

"The needle employed is a regular lumbar puncture needle, nickeloid, 18 gauge preferred, with bevelled stylet, sharp on the sides but not too sharply pointed. There is rather less variation in the depth of the tissue traversed than in the lumbar region, being in an ordinary-sized adult 4 or 5 cm., the greatest distance in the series being 6 cm. and the smallest 3.5 cm. It was found that a faint circular scratch on the needle, 6 cm. from the tip, was entirely satisfactory in judging distance, and was preferable to the deeper markings of the Patrick needle, which tend to make its insertion a little jerky and consequently less guarded."

These procedures frequently have converted a seemingly hopeless case into one of recovery. However, failure is the rule, Netter reporting 12 cases of intraventricular introduction of serum in infants with no recoveries. But the cases are desperate.

Complications of meningitis are very distressing and treatment is largely without result. *Hydrocephalus* from occlusion by the foramina may be prevented by intraventricular tapping and introduction of serum. In the cases which recover from the acute illness the operations proposed by Dandy may be suggested. *Deafness*, usually central, will improve in time in most cases. The paralysis and blindness are happily largely prevented by the use of the antimeningococcic serum.

## INFANTILE PARALYSIS

In the febrile stage the treatment of infantile paralysis is entirely symptomatic and should follow the general rules of treatment of infectious diseases given above. Isolation of the patient should be strict.

There is no specific serum of any value. Lumbar drainage does not seem to have any effect upon the limitation of the subsequent paralysis.

To limit the paralysis as much as possible, the insistence on the period of absolute rest is of great importance.

When the extent of the paralysis is definitely known, it must be treated by measures which belong to the field of the orthopedic surgeon.

## RABIES (HYDROPHOBIA)

The prevention of hydrophobia in the presence of the bite of a rabid animal is discussed in the chapter on biologic therapy and prevention in Part I.

In the presence of established hydrophobia, no treatment is available and the management of the case comes down to two matters.

1. To make the patient as comfortable as possible by the suppression of every stimulus—movement, jar of the bed, even a draught of air in the room—which might initiate a convulsion, and the use of morphine

and every other sedative. Chloroform narcosis usually has to be maintained until death supervenes.

2. Prevention of infection of the attendants by the patient—through saliva or any other excretion.

## EPIDEMIC ENCEPHALITIS

1. **Rest in Bed.**—Restraint may be necessary.

2. **Care of the eyes, ears, nose, mouth, tongue, skin and genitals** as described in Section I of this chapter. Particular attention may have to be given to the eyes on account of photophobia and diplopia.

3. **Symptomatic Treatment** is used as the symptoms arise, but opium or its derivatives should be used cautiously.

4. **Lumbar Puncture**, repeatedly done, is agreed by all who have had experience to be the only treatment of any real value. It relieves the stupor, headache and cranial nerve palsies.

5. **Hexamethylenamine** has been suggested but is probably of no value.

6. **The Skin** should be cared for well as bedsores are common.

## DIPHTHERIA

1. **Isolation.**—As soon as the diagnosis is made the patient should be isolated and an attendant selected. The patient's dishes and eating utensils should be selected and kept separate. The patient should have his own thermometer which should not be used for any one else. The attendant, whether trained nurse or member of the family, should wear a surgical gown and a face mask and cap over the hair. So should the physician when making visits. Both physician and nurse should observe special precautions against personal contamination by the patient's oral and nasal secretions. If during an examination the patient coughs into the nurse's or physician's face a careful cleansing of face and hands and a mouth wash should follow. The patient's oral and nasal secretions should be received on cloths or paper which can be burned.

2. **Local Treatment of the Mouth, Nose and Throat.**—The toilet of the mouth, nose and throat is comforting and important in order to prevent the occurrence of secondary infection. A gargle for the mouth of glycothymolin and a spray of Dobell's solution for the nose should be given once or twice a day as a routine.

If there is fetor oris the following mouth wash may be used:

℞

| | |
|---|---|
| Phenol (watery solution 1-20) | |
| Glycerin | āā ℥i 30. |
| Boric acid (saturated watery solution) | ℥viii 240. |

M.

A throat compress, as is described in the chapter on hydrotherapy, will give much comfort.

**3. Specific Treatment with Diphtheria Antitoxin.**—The technic of this is described in full in the chapter on biologic therapy in Part I.

**4. Complications.**—*Laryngeal Diphtheria* can hardly be said to be a complication, as it is reported to be present in 40 per cent of the cases. It may occur, of course, as the only manifestation of the diphtheria. In its treatment large doses of antitoxin should, of course, be given. The steam kettle, with the spout turned towards the patient, using steam alone, or compound tincure of benzoin on the water, is the second most important method of treatment.

About 30 per cent of the cases will need intubation on account of laryngeal occlusion.

The technic of intubation is as follows:

1. An intubation tube of suitable size with braided silk thread is placed on the obturator with the broad flange pointed away from the instrument. The silk thread is then to the operator's right.

2. The child is wrapped in a sheet and placed with head over the table. A mouth gag is inserted.

3. The operator stands at the patient's right, and puts the left index finger along the tongue, until the epiglottis is felt.

4. The intubator is held in the right hand and the tube is advanced along the midline of the tongue, until the epiglottis is reached when the handle of the intubator is raised and the tube inserted into the larynx.

5. The index finger holds the tube in place while the knob on the handle of the intubator is released and the instrument withdrawn. When the tube is felt firmly in place the silk thread is cut.

6. The patient must be watched to see that the tube is not coughed up. Feeding with the tube in place is difficult and should be restricted to food easily swallowed.

*Tracheotomy* and tracheal intubation may have to be done. If an emergency exists, and the patient is almost lifeless from laryngeal stenosis, the trachea should be opened with any knife which is handy just above the sternum, the edges sutured and held apart until more skilled help arrives.

*Paralysis.*—Postdiphtheria paralysis is due to a polyneuritis and occurs usually in the second or third week after the illness. It occurs in 5 to 15 per cent of the cases. Most of the cases tend to recovery spontaneously. In mild forms the patient may recover in a few weeks. Severe forms require as much as a year. The use of antitoxins after the

paralysis has occurred does not seem to be of any benefit. Great trouble should be taken to see that the patient gets enough to eat: pharyngeal paralysis may make this difficult. Orthopedic measures are valuable and give rich rewards.

*Myocarditis.*—The heart failure of diphtheria is considered in detail in the section on cardiac failure in Chapter V of this book.

*Otitis Media.*—The treatment is by paracentesis of the drum.

5. **Quarantine.**—Quarantine should be maintained until two successive throat cultures have been reported negative. Everyone who has been in contact with the case should also have a throat culture.

*Treatment of Carriers* is often very difficult. Antitoxin does no good. Holt advises a mouth wash of 1-10000 bichloride of mercury mixed one part to eight with glycerin. Other mouth washes may be tried.

*Sterilization and Fumigation* of the patient and room should properly be carried out as in scarlet fever.

## SCARLET FEVER

1. **Isolation.**—a. *Selection of Room.*—If the patient is to be treated at home the sick room should be selected with several objects in view. In the first place it should be off the beaten track of traffic in the household; in the second place it should be roomy, airy and light. In the third place it should be such that nearly all articles in the room can be removed and the walls repapered or repainted after the patient leaves. Scarlet fever is one of the diseases in which the contagion remains upon external objects for a long time. The sick room should also be near a bathroom.

b. *Distribution of the Family.*—If there are children in the family they should be taken outside the house and kept away from contact with other children for fourteen days. Adults are less susceptible but should not be unnecessarily exposed.

2. **Prevention of Infection.**—a. *Nurse and Doctor.*—The nurse and doctor should wear gown, cap and mask and rubber gloves when handling the patient, as described in Section I of this chapter. An antiseptic spray of the nose and mouth seems to be of some benefit.

b. Segregation of the patient's thermometer, dishes and utensils, as described above.

c. Disinfection of stools, urine, bed pans, urinals, bed linen, night gown and so forth, as described above in Section I.

3. **Rest in Bed.**

4. **Care of the eyes, ears, nose, mouth, tongue, teeth** is perhaps more important in scarlet fever than in any other disease as the complications

from nose and throat infection are so dangerous, and in scarlet fever the nose and throat are usually involved.

5. **The Care of the Skin.**—A tepid sponge bath once a day is usually well borne, although sometimes the skin is so sore as to make this impossible. Itching and burning of the skin may be allayed by sponging with a solution of soda bicarbonate—a teaspoonful in three pints of water—or the application of zinc oxide lotion, or calamine lotion. When desquamation begins, vaseline may be applied to the desquamating surfaces to hasten removal and prevent their being dusted about the room.

6. **The Bowels** should be opened at the beginning and kept open with mild cathartics; in the case of children a phenolphthalein preparation.

7. **Diet.**—At the beginning it is usually advised to give only milk and cream—two quarts of milk and one pint of cream a day. Later ice cream, milk toast, rice and barley water may be added, always watching the urine.

8. **Scarlet Fever Antitoxin** has proved curative value. For discussion of its dosage and effects see Chapter III, Part I.

9. **Use of Convalescent Serum.**—For technic see Chapter on Biologic Therapy in Part I.

10. **Treatment of Symptoms.**—*Nausea* should be treated by giving cracked ice, small doses of soda bicarbonate or cerium oxalate, grains 2 to grains 5. *Itching of the skin* is a prominent symptom, its treatment is described above. When the soles of the feet are involved carbolic acid ointment placed on overnight gives relief in most cases. Itching of the scalp may be treated by washing the scalp with alcohol and rubbing in white vaseline. *Fetor oris* and *sore throat* may be treated with Dobell's solution as a gargle or local applications of silver nitrate. *Hyperpyrexia* should be treated by icebags to the head and sponge baths.

11. **Complications.**—a. *Diphtheria* is a common associate of scarlet fever and should be treated by the usual methods for diphtheria.

b. *Otitis Media.*—The ears should be watched daily in scarlet fever and puncture done if otitis media develops.

c. *Nephritis.*—The urine should be examined daily. The nephritis may be very mild, presenting only an albuminuria, or there may be albuminuria and dropsy, or lastly there may be fulminating forms with hematuria, or suppression, uremia, convulsions and so forth. The principles of treatment of nephritis will be found in the chapter on diseases of the kidneys in Part II of this book. The milder forms should be treated with salt-free, dry, bland diet, sweat baths, and so forth. Convulsions should be treated by lumbar puncture, free catharsis, sweating and so forth.

d. *Noma.*—Should be treated as in measles.

12. **Quarantine and Fumigation.**—The quarantine period of scarlet fever is six weeks after desquamation has begun, and after all discharges, which may have occurred from the nose and ears, have stopped. Holt says that a child released from quarantine of scarlet fever should not sleep with other children for three months. When the child is to be released from quarantine, he should be stripped in the sick room and carried into the bathroom and given a soap and water bath. The head should be well shampooed with soap and water and 1-2000 bichloride solution. The ears should be irrigated with 1-8000 bichloride solution. The nose should be sprayed with an antiseptic solution; Northrup advises 1-8000 bichloride. Northrup also advises that after the soap and water bath the child should be bathed in a tub bath of 1-8000 bichloride solution for 20 minutes. After proper cleansing the child should be taken to a room other than the sick room and dressed in clean clothes.

The sick room needs very thorough cleaning and fumigation. All the bed clothes and night clothes should be boiled for an hour, or sterilized by steam, under pressure. The toys and books used by the child should be burned. The room should be washed down, the floor and woodwork scrubbed and the room fumigated with formaldehyde as described in Section I of this chapter. The walls of the room should be repapered or repainted.

## MEASLES

1. **Isolation.**—As in scarlet fever. See above.

2. **Prevention of Infection.**—As in scarlet fever. See above.

3. **Rest in Bed.**

4. **Care of the Eyes, Ears, Nose, Tongue, Mouth, Teeth.**—As described for all infectious diseases in Section I of this chapter.

5. **The Eyes** should receive special attention. The room should be darkened or colored glasses worn.

6. **Care of the Skin.**—As in scarlet fever.

7. **Bowels.**—Opened by initial catharsis and kept open.

8. **Diet.**—Soft to light.

9. **Fresh Air** is very important to allay coughing and prevent respiratory complications.

10. **Inhalation of Tincture of Benzoin, or Steam Croup Kettle** to soften bronchial secretions.

**11. Complications.—**

a. Bronchopneumonia must be treated as pneumonia.

b. Otitis media: The ears should be inspected daily and puncture made when indicated.

c. Adenitis: Cervical adenitis occurs in 2 per cent of the cases. It should be treated by local applications of heat, painting with ichthyol and incision if necessary.

d. Noma and Ulcerative Stomatitis: These serious complications occur more frequently in measles than in any other disease; so for this reason the toilet of the mouth in measles should receive particular attention. When the ulcerative stomatitis begins, a mouth wash of chlorate of potash ¼ per cent should be used. The edges of the ulcer should be touched with hydrogen peroxide solution, tincture of iodine solution, or a weak solution of arsphenamine. When noma occurs, the edges of the gangrenous process must be cauterized with fuming nitric acid, or pure carbolic acid after the gangrenous tissue has been cut away. The actual cautery may have to be used.

**12. Quarantine and Fumigation.**—The quarantine period of measles is short. A week after the disappearance of the rash is plenty of time to allow the child to be up. The virus of measles does not seem to cling to external objects with any of the tenaciousness which scarlet fever does. The patient should be bathed in soap and water and shampooed. The bed clothes and night gowns should be boiled, the room thoroughly aired and fumigated with formaldehyde, as described in Section I of this chapter.

## GERMAN MEASLES

Should be treated along lines indicated in Section I of this chapter. The disease is usually so mild as to make nearly any treatment superfluous.

## SMALLPOX

**1. Isolation.**

**2. Rest in Bed.**

**3. Protection of Nurses, Attendants, and Doctors** by caps, gowns and masks.

**4. Care of the Eyes, Nose, Mouth, Teeth and Tongue** as described in Section I of this chapter.

**5. Treatment of the Skin.**—Burning and itching may be allayed by solutions of soda bicarbonate, laid on with wet cloths. The pocks should

be treated, at an early stage, by touching each one with a cotton applicator saturated with tincture of iodine. When the scabs begin to form they should be rubbed with vaseline.

**6. Symptomatic Treatment.**—There is no specific treatment for smallpox and the symptoms must be treated as they arise as described in Section I of this chapter.

## CHICKENPOX

**1. Isolation** should be advised, but not insisted upon.

**2. The Care of the Skin.**—Scratching should be avoided and the pustules opened with a sterile needle and touched with half strength tincture of iodine. When scabs form they may be treated with the application of vaseline.

**3. Medication.**—None is usually required.

**4. Quarantine** should be maintained only until the scabs have disappeared. Airing and cleaning the room is sufficient. Fumigation is not necessary.

## WHOOPING COUGH

**1. Isolation.**—The disease is not often considered serious enough to demand isolation, but this is a mistake as the mortality is quite high. The patient may usually be up and about.

**2. Fresh Air.**—Patients do better in fresh air or in the open air. The clothing should always be warm with flannel next the skin.

**3. Diet.**—The diet need not be considered except in relation to the vomiting induced by paroxysms. If the vomiting is serious enough to entail emaciation, it should be carefully considered and feeding encouraged between attacks.

**4. Mechanical Support of the Abdomen and Chest.**—This procedure first recommended by Kilmer is of great value. "A stockinette band is placed upon a baby in the same manner as is done by orthopedists before applying a plaster paris jacket. This band extends from the axilla to the pubes and fits the baby snugly. Two shoulder straps are used to prevent the band from slipping down. Upon this stockinette band a single width of elastic bandage is sewn, extending entirely around the body and covering the abdomen. The bandage is sewed on when very slightly on the stretch." (Kilmer.)

**5. Medical Treatment.**—Antipyrine can be given, 1 grain every three hours, to a child six months old. At a year old the dose may be increased to a grain and a half, and at two years, two grains.

Tincture of belladonna is employed up to its physiologic limit to control the paroxysms. The dose is started according to the age of the child, with 1 to 6 drops, three a day. Jacobi says: "Unless the drug cause a feverish flush on the cheeks within half an hour, which must last half an hour or more, it has no effect." The dose of belladonna must be increased until such an effect is attained at every dose.

6. **Specific Treatment.**—The use of the specific vaccine does not seem to be of very great value.

## MUMPS

1. **Isolation** should be advised in all cases.

2. **Rest in Bed** during the acute stage should be insisted on to prevent involvement of the testicles in boys or the ovaries in girls.

3. **Hot or Cold Applications to the Parotid Region.**

4. **Medical Treatment** is usually unnecessary.

## SYPHILIS

The combination and method of administration of the drugs used in the different stages and forms of syphilis may be summarized, representing the most scholarly modern opinion, thus:

**Prophylactic Treatment.**—Thirty-three per cent calomel in lanolin smeared over the penis and the scrotum within a few hours after contact or suspicious intercourse will greatly diminish the chances of contagion.

**Primary Stage.**—Diagnosis made by finding spirochetae with the dark field microscope. The Wassermann still negative, 0.6 gm. arsphenamine or 0.9 neoarsphenamine every three or four days for six to ten doses, followed by mercurial inunctions or intramuscular injections twice a week for 6 to 10 weeks. If Wassermann is still negative and no secondaries have appeared, this may be sufficient. This is the ideal time for complete cure.

**Secondary Syphilis.**—(See Table XXII.)

Table XXII

| Drug | Dose (Average) | Number Doses to a Course | Method of Adminis-tration | How Often | Number of Courses | Interval Between Courses |
|---|---|---|---|---|---|---|
| Arsphenamine or Neoarsphenamine | .6 gm. .9 gm. | 10 | Intra-venous | 4 days apart | Minimum of three | One month |
| Mercury Bichloride | ½-1 gr. | 20 | Intra-muscular | Every other day | Minimum of three | Between arsphenamine courses |

These three courses should be given independently of the Wassermann. If the Wassermann has changed from positive to negative, treatment may be suspended for a few months, and then the blood serum again tested for the Wassermann reaction. Treatment should be carried on and repeated for some time as above outlined, depending somewhat on the Wassermann. Bismuth should be substituted for mercury, at least for a trial period, in Wassermann-fast cases.

**Tertiary Syphilis.**—*Gummata.*—The iodides and mercury come to the fore here. Neosalvarsan .9 gm. or .7 gm. or less may be given once a week for five to six weeks.

*Hepatic and Vascular Syphilis* do better on mercury and the iodides without arsphenamine (see article by Wile in the Am. Jour. Med. Sc., 1922).

*Neurosyphilis.*—There may be vascular neurosyphilis (hemiplegias, etc.) which should be treated as tertiary syphilis.

Meningeal, exudative types—cerebrospinal lues and the degenerative forms (tabes and paresis)—should be treated by the Swift-Ellis procedure or its modifications, tryparsamid the intraspinal mercurial treatment of Byrne or malarial inoculation. It seems well established that there are forms of the spirochete which have an especial affinity for the nervous tissues. It should be remembered that the spinal fluid may show a positive Wassermann in these forms while the blood is negative.

*Swift-Ellis* method of intraspinal salvarsanized serum:

1. Intravenous .4 gm. to .6 gm. arsphenamine.

2. Thirty minutes later 60 c.c. withdrawn from other arm.

3. The blood is allowed to clot, the serum pipetted off and inactivated at 56° C. for an hour.

4. Lumbar puncture is done. The 30 c.c. of spinal fluid withdrawn and 30 c.c. of the serum allowed to flow in by gravity.

Six to ten such treatments, one every two weeks may constitute a course.

*Ogilvie* has modified the original Swift-Ellis technic by the principle of reinforcement of the serum, adding $\frac{1}{5}$ milligram (later increasing to $\frac{1}{4}$ and $\frac{1}{3}$ milligram) of arsphenamine to the serum in alkaline solution and incubating for half an hour before introduction into the spinal canal.

Some clinicians simply give intravenous arsphenamine and drain the spinal fluid at the same time. This allows more arsphenamine to enter the central nervous system than by arsphenamine injection alone. For the rationale see the chapter on lumbar puncture.

*Method of Byrne.*—Bichloride of mercury $\frac{1}{50}$ grain added to 30 c.c. of blood serum given intraspinally. Tubes with the bichloride in horse serum are on the market put up by reputable drug firms.

*Tryparsamide.*—See Chapter II.

*Malarial Inoculation.*—See Chapter III.

**Congenital Syphilis.**—Particular attention is called to the method recommended for congenital syphilis. It is radically different from the

Fig. 74.—Infant with congenital syphilis, one week old.

methods recommended in most textbooks; mercurial inunctions are usually recommended. It has been used by my colleague Dr. C. C. Dennie in an enormous experience with remarkable results.

**Acute Congenital Syphilis.**—Baby at age of one to three weeks .001 gm. (1 mg.) of neoarsphenamine in 5 c.c. distilled water, *in the vein of the arm* (it is not necessary to put it in the frontal sinus as usually advised). An ordinary hypodermic needle is used.

This is repeated for 8 doses, a week apart. The dose is gradually raised to .005 gm. neoarsphenamine.

During this period and following it mercury with chalk is given by mouth, 1/8 grain every other day, for six weeks to two months.

Three of such courses are given.

The dosage of neoarsphenamine rises to .1 gm. for a child of 1 to 3 years. At this age the course consists of 8 doses, followed by intramuscular mercury, 1/8 grain of the bichloride every week.

| | | | |
|---|---|---|---|
| Age | 3-5 years | .15 gm. | neoarsphenamine. |
| Age | 5-10 " | .2 " | " |
| Age | 10-14 " | .25 " | " |

Fig. 75.—Treatment of congenital syphilis. Same patient as the one shown in Fig. 74, one week after injection of arsphenamine in vein of arm. (Case of Dr. C. C. Dennie.)

## THE TREATMENT OF PULMONARY TUBERCULOSIS

The methods employed in the treatment of pulmonary tuberculosis have been carefully described in Part I of this book. Here a summary will be given, and reference made to the previous description.

**1. Rest** is the most important of all elements in the treatment. It should be adhered to absolutely, day and night, upon a bed or a steamer

chair for a period representing at least the first six months of treatment. If temperature has been normal for several weeks at the end of this period, exercise may be begun very gradually.

2. **Open Air.**—The patient's bed or chair should be as nearly as possible in the open air. A porch to protect from rain and snow is allowed. The patient must be warmly clad, as the object of the application of fresh air is not to chill the surface of the body. (See pages 400-404.)

3. **Extra Food.**—See Chapter on Diet. Part I. (See pages 295-299.)

4. **Climate.**—See Chapter on Climate. Part I. (See pages 404-406.)

5. **Specific Treatment.—Tuberculin.**—See chapter on biologic therapy, Part I. (See pages 209-215.)

6. **For Late Cases.—Artificial Pneumothorax.**—See Part I. (Pages 452-466.)

7. **Drugs.**—"The false specifics." The drugs which have been recommended in the treatment of pulmonary tuberculosis are numerous. Many of them are of considerabe value as adjuncts in the treatment.

*Creosote* first introduced in 1830, was considered a specific at the time on account of the rapid improvement shown by patients. It was given at first in too large doses and for that reason fell into disrepute. Later it was taken up again, and the fact that it is still used so widely, would make us believe that there is some virtue in its administration. By some it is supposed that its principal benefit comes from the destruction of tubercle bacilli in the gastrointestinal tract, which are inevitably swallowed by consumptives. At any rate it improves appetite, deodorizes sputum, and improves nutrition. It is best administered in capsules. I furnish my patients with a bottle of creosote, a dropper and some empty capsules, and instruct them to open a capsule, put one or two drops of creosote in it, close the capsule and swallow with a drink of warm water. One, two or three drops may be given three times a day.

*Cod-liver Oil* has been used in tuberculosis for many years. It was many times considered a specific, and we must believe from the long empirical treatment, which it has been through, that it must have considerable virtue. Some authors have believed that it was beneficial because of its iodine content, others that it had a high lecitid content. Recently the demonstration that it contained large amounts of fat-soluble vitamine-B has made us believe that it is this substance which is responsible for its good effect on nutrition. It should be given in large doses, at least two ounces a day.

*The Hypophosphites* have been used on the theory that tuberculosis is a manifestation of mineral starvation, particularly lime starvation. They are at least harmless and their tonic effect is unquestionable. In

cases of very early or suspected tuberculosis they may help by supplying lime to improve nutrition to such an extent as to make us believe that the tuberculosis has been aborted.

8. **Symptomatic Treatment.**—*Cough.*—The best treatment of cough is open air. The cooler the air the better. Creosote is also valuable in diminishing cough. The opiates are seldom necessary.

*Fever.*—Rest is the only sensible treatment of fever. The earlier the case the sooner the fever will come to normal.

*Hemorrhage* often needs no treatment. Morphine to quiet the cough and restlessness, an ice bag to the chest and horse serum or thromboplastin are palliative forms of treatment. The best treatment of all is artificial pneumothorax.

*Night Sweats.*—Open air treatment is best. Medical treatment of night sweats is not very satisfactory and not to be encouraged. They usually can be controlled by rest and open air treatment. An alcohol rub before retiring, or a sponge with 3 per cent lysol solution may be valuable. Atropine, Dover's powder, and brandy are the medicines usually used.

*Diarrhea.*—Fishberg has recommended the intravenous use of calcium chloride in diarrhea of tuberculous origin using 5 c.c. of a 5 per cent solution. Sometimes one dose is sufficient. If this is not effective, the ordinary treatment of diarrhea with opium and albutannin should be given.

## References


### *Pneumonia*

Bastedo: Pulmonary Edema in Pneumonia and Its Treatment, Jour. Am. Med. Assn., Sept. 8, 1917, lxix, No. 10.

Cecil and Larsen: Clinical and Bacteriologic Study of One Thousand Cases of Lobar Pneumonia, with References to the Therapeutic Value of Pneumococcus Antibody Solution, Jour. Am. Med. Assn., July 29, 1922, lxxix, No. 5.

Cohn: Action of Digitalis in Pneumonia, Jour. Exper. Med., Jan. 1, 1917, xxv, No. 1.

Means and Barach: Symptomatic Treatment of Pneumonia, Jour. Am. Med. Assn., Oct. 15, 1921, lxxvii, No. 16.

Peterson and Levinson: Therapeutic Effect of Venesection with particular reference to Lobar Pneumonia, Jour. Am. Med. Assn., Jan. 28, 1922, lxxviii, No. 4.

Rosenow: Partially Autolyzed Pneumococci in the Treatment of Lobar Pneumonia, Jour. Am. Med. Assn., March 16, 1918, lxx, No. 11.

Solis-Cohn: Present Status of the Definite Treatment of the Pneumonias, Jour. Am. Med. Assn., Dec. 6, 1919, lxxiii, No. 23.

Thomas: Type I Pneumonia and Its Serum Treatment, Jour. Am. Med. Assn., Dec. 31, 1921, lxxvii, No. 27.

### *Acute Articular Rheumatism*

St. Lawrence, Wm.: Effect of Tonsillectomy on the Recurrence of Acute Rheumatic Fever and Chorea, Jour. Am. Med. Assn., October, 1920, lxxv, No. 16.

### *Tetanus*

Meltzer: Inhibitory Properties of Magnesium Sulphate and their Therapeutic Application in Tetanus, Jour. Am. Med. Assn., March 25, 1916, lxvi, No. 13.

Park and Nicoll: Experiments on the Curative Value of the Intraspinal Administration of Tetanus Antitoxin, Jour. Am. Med. Assn., June 18, 1914, lxiii, 235.
Robertson: Therapeutic Action of Tetanus Antitoxin, Am. Jour. Med. Sc., June, 1916, cli, No. 6, p. 87.
Stone: Treatment of Tetanus, Jour. Am. Med. Assn., June 24, 1922, lxxviii, No. 25.

### *Epidemic Meningitis*

Cushing and Sladen: Obstructive Hydrocephalus, Following Cerebrospinal Meningitis with Intraventricular Injection of Antimeningitis Serum, Jour. Exper. Med., 1908, x, No. 4, p. 548.
Dopter: Diagnostic et Traitement de la Meningite Cerebrospinale, Paris, 1918, Reviewed with plates in Jour. Am. Med. Assn., July 6, 1918, lxxi, No. 1.
Flexner: Jour. Am. Med. Assn., Sept. 1 and 8, 1917, lxix, No. 9 and 10.
Hoch: A Case of Cerebrospinal Meningitis Successfully Treated by Intraspinal and Ventricular Administration of Anti-meningitic Serum, Boston Med. and Surg. Jour., March 7, 1918.

# CHAPTER XV

## THE TREATMENT OF DISEASES DUE TO ALLERGY

A whole group of diseases heretofore apparently not related in any way, have been subjected, within recent years, to a study which has determined, by now conclusively, to most scientific minds, a common basis for them. They are all expressions of allergy, or a sensitiveness of some parts of the body to a protein (or in a few cases a nonprotein) material, which enters the blood stream either by way of the digestive system, the respiratory system, the eye, or, in rare cases, through the skin (dermatitis venenata) or by subcutaneous injection for therapeutic purposes (horse serum).

These conditions may profitably be studied as a whole.

### I. THE NATURE OF HYPERSENSITIVENESS—ANAPHYLAXIS—ALLERGY—IDIOSYNCRASY

Shortly after the introduction of diphtheria antitoxin reports came from various clinicians, of the occurrence of severe generalized urticarial eruptions following the employment of the serum. It was at first supposed that it was due to the antitoxin, but von Pirquet and Schick showed that it was due to the horse serum. They also showed that it occurred only when the serum was introduced into the body parenterally—i.e., subcutaneously or intravenously, not through the medium of the digestive tract. These earlier investigators are also responsible for the demonstration that after an initial dose of a foreign protein the tissues of the animal body are permanently altered, and this protein injected or scratched into the layers of the true skin will produce an urticarial wheal.

The work of Rosenau and Anderson closely followed these findings. They discovered that if horse serum is introduced in considerable quantity into the peritoneal sac of a guinea pig, no untoward symptoms result, but that if after an incubation period of 8-12 days, a very small amount of horse serum is again introduced into the peritoneum or the vein, the animal gives evidence of great distress, has marked dyspnea and convulsions and usually dies. At autopsy the guinea pig's lungs are greatly distended, pale and tense and on histologic section the terminal bronchioles seem to be in spasm. Other animals will also have a reaction after the second dose of a protein but the symptoms and

autopsy findings vary somewhat in different species; in the dog, for instance, the digestive tract and cardiovascular system seem to be the point of the maximum intensity of the symptoms.

These phenomena were considered at the time to be of a nature exactly the opposite of immunity because whereas the injection of a toxic infectious substance will produce an increased power of the body to destroy it when later introduced, in these experiments the previous introduction decreased the body's power of resistance. The condition was therefore named anaphylaxis, the opposite of prophylaxis. Later work has served to show that the mechanism of immunity and the mechanism of anaphylaxis are not so dissimilar as was once supposed. There is probably a true antigen-antibody reaction in anaphylaxis as well as in immunity.

It was found, to emphasize this point that, if before the second and poisonous dose of the serum is given, the animal receives intravenously a very small dose of serum, amounting to about 1:20,000 of the amount required for the production of anaphylactic shock, the later administration of the shock will fail of its usual effect. In the serum disease of man also the hypersusceptible individual may to a certain extent be protected from the expected reaction (i.e., be desensitized) by the subcutaneous or intravenous administration of small amounts of the serum. The only explanation of such phenomena yet advanced is that this smaller amount of antigen unites with circulating antibodies and thus prevents the subsequent reaction.

Otto showed that sensitiveness can be transferred from one animal to another in the serum. Thus if guinea pig "A" receives an injection of horse serum, and a few days later is bled and the blood serum injected into guinea pig "B" in 24 hours "B" will be in a state of anaphylactic hypersensitiveness and will react to the usual dose of serum necessary to produce anaphylactic shock. This hypersensitiveness can be transferred before the ordinary incubation period is ended; and it can be transferred even after pig "A" has been desensitized by minute doses of the serum. This passive sensitization does not last so long as the active sensitization. And the power to produce passive sensitization disappears from the actively sensitized animal long before its own sensitization has gone.

A further observation of Otto's is that actively sensitized females can transmit their hypersensitiveness to their young.

The explanation of these phenomena have been numerous. None of them is as yet very convincing. There is a general concensus of opinion that there is an antigen-antibody reaction present. One group of workers believe this to be of a chemical nature, that the primary injection pro-

duces a substance which unites with the second injection of the antigen to form a poisonous product. Another theory has been that the reaction is physical in character, the poison being elaborated by "the cleavage of serum proteins (and proteoses) through the pepton stage by a nonspecific proteose." A third general group of ideas has centered in the belief that the process differs from immunity in that the immunologic processes take place in the blood serum while the anaphylactic phenomena take place in the fixed body cells. Vaughn and Wheeler state the theory thus: "When a foreign protein is introduced into the blood or tissues it stimulates certain body cells to elaborate the specific ferment which will digest that specific protein. When this protein first comes in contact with the body cells the latter are unprepared to digest the former, but this function is gradually acquired. The protein contained in the first injection is slowly digested and no ill effects are observable. When subsequent injections of the same protein are made, the cells prepared by the first injection pour out the specific ferment more promptly and the results are determined by the rapidity with which digestion takes place. The poisonous group in the molecule may be set free rapidly and in amounts sufficient to produce symptoms or to kill the animal."

It has been a very short step from the knowledge of these anaphylactic phenomena to the comparison of them with certain clinical conditions. Hay-fever was early seen to be a sensitization of the organism to vegetable proteins. Certain forms of skin eruption—urticaria and primrose dermatitis—fall in the same category. Finally Schloss and Talbot showed that in infants certain foods even of the commonest sort, such as milk and eggs, could cause symptoms such as asthma, urticaria, etc., when no particular digestive disturbance was present, and that, following the idea of von Pirquet and Schick, these idiosyncrasies could be predicted and diagnosed in a given individual by the injection or vaccination of the responsible foods into the skin.

These conditions were at first all grouped under the general name of anaphylaxis. But it was soon pointed out that the natural states of hypersensitiveness were somewhat different to the acquired condition. A most important difference consisted in the fact that there was in them no first introduction of the protein to which the individual is sensitive. The sensitiveness was manifest at the first application. It was supposed that in all these cases the first introduction had been made some time before the time symptoms were manifested. But in certain cases, for instance, in serum disease, the previous subcutaneous injection of horse serum could manifestly never have taken place. Other differences were pointed out in the two conditions and the name *Allergy* given to

the hypersensitiveness observed in man as a natural (not acquired) phenomenon. This includes hay fever, urticaria, dermatitis venenata, food allergies, drug idiosyncrasies and serum disease.

An important feature of allergy is that it is hereditary, transmitted both in the male and female line. This is easily observed in hay fever —almost invariably it occurs in father and children or mother and children or sister and mother in the same family. Furthermore the general state of allergy may be transmitted. It is not uncommon for an individual to be sensitive to one substance and later develop sensitiveness to quite another. For instance in hay fever, patients may find that they develop asthma during the hay fever season when they eat some particular fruit. Allergy differs from anaphylaxis in the fact that it is not possible to transmit sensitiveness in the serum from one animal to another. (Some isolated observations would seem to contradict this

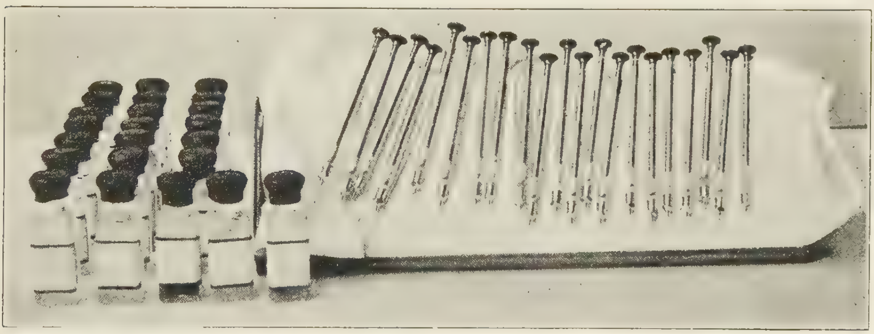


Fig. 76.—Table prepared for instruments for tests of skin sensitiveness by the intradermal method. Tuberculin syringes fitted with No. 26 needles fresh from the sterilizer. Bottles containing allergen solutions, fitted with rubber tops.

statement, but they have not been confirmed.) Attempts to transfer allergy from one human being to another have never been successfully made so far as I am aware.

Making extracts of the protein to which the patient is sensitive, and giving them hypodermically in gradually increasing dosage, like a vaccine, will in most cases, to some extent, cause desensitization. Hay fever may with reasonable success be prevented in this way in about 80 per cent of patients.

It appears universal and of considerable practical interest that the reactions of allergy occur in the fixed cells of the body. Rackemann considers this to be the fundamental difference between allergy and immunity. In immunity the reactions occur in the circulating blood. In hay fever, for instance, the cells of the conjunctiva, the nasal mucosa and, when asthma intervenes, the unstriped muscle cells of the bron-

chioli are involved. The work of Mackenzie and Baldwin in hay fever tends to show that if the pollen extract to which the patient is sensitive be injected into the skin at first a marked reaction occurs, but if it be reinjected again and again in the same spot the reaction soon disappears at that point though it may still remain in other portions of the skin surface.

## II. DISEASES DUE TO ALLERGY

### 1. Asthma

**The Musculature of the Bronchi.**—In the trachea and larger bronchi there are some unstriped muscle fibers, but the concentric cartilaginous rings prevent complete collapse of their lumina. In the smaller bronchi the cartilage gradually disappears until when we reach the terminal bronchiole it has entirely gone, its place being taken by elastic tissue. The muscle fibers in the cartilaginous bronchioli were first described by Reisseisen as being attached to the bronchial cartilages and spreading out between the spaces; where the cartilages terminated, however, the muscle did not, but could be followed "in the lungs of an adult robust man as far as it was possible to open a bronchial tube with a scalpel." Various subsequent investigators have given somewhat contradictory descriptions of this muscle. Sappey considers the muscle layer to be continuous over the bronchioli, much like the muscular layer of the intestinal wall. Dubreuil and Lamarque as well as Toldt considered it to be a network. Toldt called it a latticework. Dubreuil and Lamarque consider that the muscle forms a plexiform sphincter around the alveolar canal and that it extends into the walls of the air sacs.

W. S. Miller, who has added so much to our knowledge of the anatomy of the lung, has recently reviewed the subject and made dissections upon the lung of the guinea pig, the dog and man. It is worth noting that he states that the "lung of the guinea pig contains proportionately a larger amount of smooth muscle than that of any other animal I have studied"; a significant statement in view of the marked lung reaction of the guinea pig in anaphylactic shock. The musculature of all three animals, Miller found to be much similar in that it formed a network of geodesic bands. In none did it form a continuous sheet or circular band. The arrangement is such as "to prevent any tangential motion and in this way provide for the greatest amount of strength and at the same time permit the greatest amount of extension and contraction of the bronchioli and their subsequent divisions." The muscle bands form a sphincter around the openings of the air sacs, but no muscle bands are found in the alveoli proper. "The muscle belongs to

the air tube and not to the alveolus.'' Miller believes also that the action of the bronchial musculature in expiration is active rather than passive.

The innervation of these muscle fibers we know largely by implication from pharmacologic experiment. They are, of course, under the control of the involuntary or vegetative nervous system. The cerebral, or vagus, sends some fibers and in accordance with the rule of double innervation of the organs under control of the vegetative nervous system, the sympathetic does also.

Stimulation of the vagus causes a contraction of the bronchial muscles. But the proposition put forward by certain authors of considering asthma as an expression of vagus stimulation, breaks down when we remember the experiments of Auer and Lewis who found that anaphylactic shock with the characteristic lung findings could be produced in the guinea pig even after section of the vagus. It is possible, however, to produce bronchial spasm by vagus stimulation; and this probably accounts for certain cases of asthma due to nasal, laryngeal and tracheal disease or pressure. Von Schötter, Jr., produced an asthmatic paroxysm in a patient while making a laryngeal examination. In very sensitive individuals faradization of the nasal mucosa will induce a paroxysm.

The action of atropine will relax an asthmatic attack, but requires rather large dosage in most cases. Epinephrin acts more certainly and more promptly. Atropine, as we have seen, has the action of a general paralysant to the autonomic nervous system and thus of the vagus. Epinephrin stimulates the sympathetic. From its prompt action in asthma we deduce that the sympathetic innervates dilator fibers in the bronchial musculature. The weaker action of atropine is explained by supposing that in allergic asthma the spasm of the muscles is caused by the hypersensitiveness of the muscle fibers themselves not to vagus stimulation.

**Pathology of Asthma.**—There is a general tradition among medical men, that asthma never causes death and that, for this reason the pathology of the disease is unknown. As a matter of fact there are a number of cases of death with autopsy now on record. Boughton has reported the case of a man who died during an asthmatic attack induced by the injection of a small amount of horse serum given for the purpose of desensitizing him previous to an injection of a therapeutic serum. He died in 45 minutes and at autopsy his lungs were found dilated and the bronchioli on section were contracted much like the lung of a guinea pig in anaphylactic shock. The dose of horse serum he received was one minim. He had had asthma when near horses all his life

Kamchorn and Ellis have reported the autopsy upon a man who had asthma all his life and died of intercurrent cardiac disease. There were no permanent changes in the lungs or bronchi to account for the asthma. In other words the case is confirmatory of the supposition that asthma is due to a temporary condition (of spasm).

Huber and Koessler have studied material from the bodies of six persons who died of asthma. Their findings are of the greatest importance. There was a marked thickening and infolding of the bronchial mucosa and an hypertrophy of the smooth muscle of the bronchiolar walls. Some of the cases were of the bacterial type and some of the purely allergic type. It seems evident that in the severe forms with great bronchorrhea or spasm or both not only are the bronchi sensitized but actual organic change supervenes in the bronchial mucosa and musculature which is the cause of the continuance of the asthma even after the cause of sensitization has been removed.

**The Treatment of Asthma.—Treatment of the acute attack.**—Epinephrin is our most valuable drug for any attack of asthma, due to whatever cause. It should be given intramuscularly or intravenously. It is sometimes advised to give it on the tongue and allow it to be absorbed there, but this means or any other oral administration is seldom effective. I agree with Hurst who says that the one time when it is permissible to teach a patient to use a hypodermic syringe is in the case of an asthmatic who should be taught to give himself an intramuscular injection of epinephrin and to have his syringe and solution ready at his bedside. An intramuscular injection is nearly as effective as an intravenous one as the small venules in the muscle take up the solution much as if it were in a vein. The dose of the epinephrin solution must be determined by the experience of the patient and the severity of the attack. If the patient is not susceptible doses up to 20 or 30 minims (1.5 to 2 c.c.) can be given. The average dose is 10 minims to 15 minims (about 1 c.c.). The only disadvantage of epinephrin is the short duration of its effects. However it can be given repeatedly within reasonable limits. Hoxie and Morris have reported a case of death due to prolonged adrenalin administration, but in this case the drug had been administered in enormous doses daily to the amount of 7 c.c. for six years, and the evidence in the case is complicated by the presence of asthma and the use of chloroform and morphine in small amounts; however if deprived of the adrenalin the patient developed a cyanosis of the lips and fingers.

Ephedrine sulphate has been extensively used as a substitute for epinephrin in the treatment of asthma. Its pharmacologic action is similar to epinephrin and it has the advantages that it is absorbed when taken

by mouth, and that its action continues over several hours. All patients cannot, however, take it comfortably on account of the distress in the stomach, and many of my chronic asthmatic patients who gave up epinephrin to try ephedrine have returned to the original drug, preferring the discomfort of the hypodermic injections and the skin irritation to the epinephrin to the disagreeable by-effects of the ephedrine.

Morphine and atropine are, in combination, nearly always effective. Benzyl benzoate and benzyl succinamide have been useful in my experience, and have the advantage of the possibility of oral administration. They are not always certain to relieve the spasm.

The burning of asthma powders and smoking of asthma cigarettes is an old and not very effective remedy. Stramonium and belladonna leaves are the base ingredients of such powders. A formula that may be used is:

℞

| | |
|---|---|
| Stramonium foliorum | ʒiv |
| Anisi fructus | |
| Potassii nitratis | āā ʒii |
| Tabaci foliorum | gr v |

**Treatment of the Chronic Underlying Condition** in asthma depends upon the determination of the cause. The classification which I submit is based upon my experience with asthma in hospital, dispensary and private practice during the last four years.

**I. Asthma Due to Organic Causes.**—Mediastinal growths, particularly aneurysm, may by pressure on the trachea cause typical attacks of bronchial asthma.

I shall not soon forget a case I saw while I was serving my interneship at the Augustana Hospital, Chicago, in 1908. One hot summer night a man was brought to the hospital in an acute attack of asthma. He had never had such an attack before. He had been out walking with his wife, when he was suddenly attacked with the asthmatic paroxysm. With a dose of morphine and atropine he was relieved, and, though urged to enter the hospital as a patient, he went out. Several days later he returned, still suffering with his asthma and remained in the hospital five days. I was called to see him in the middle of the night. He had fallen on the floor of his room, with a hemorrhage from his throat and when I reached him was dead. At autopsy an aneurysm of the transverse arch of the aorta had constricted the trachea so that it was no larger than the thickness of a silver dollar.

Thymic asthma has long been known in children due to a large persistent thymus. The treatment by x-ray of the chest is very satisfactory.

**II. Reflex Asthma, Nasal Asthma, Chronic Bacterial Asthma.**—The relation between chronic nasal disease and bronchial asthma has long been recognized. The usual explanation has been that it is reflex. No certain reflex arc has ever been proved to exist, however, and a recent review of the literature has been almost fruitless in uncovering any experimental work which proves that stimulation of the nasal mucosa will cause even bronchial spasm, let alone true asthma. Several reports have been made tending to show that removal of the nasal disease did not relieve the asthma. Kahn reviewed a series of patients who were followed for some time; no cures of the pre-existing asthma followed the nasal surgery. Lintz criticized a report of Gottleib's by saying that the only thing the report proved was that "intranasal operation as a cure for bronchial asthma is futile."

There is, nevertheless, no doubt as to the frequent association of nasal infection and bronchial asthma. In fact such patients form the largest single class of asthmatics aside from the strictly allergic patients. In a series of fifty consecutive cases of asthma reported by me, in which all allergic tests were negative, forty-eight had had a chronic nasal "catarrh" for from five to twenty years before the asthma began. The older clinicians were actively aware of the association between asthma and colds. Merkel, in 1861, stated that in his opinion asthma was usually complicated by catarrh, emphysema, and heart disease. Unger, in 1880, said that asthma is unquestionably caused by a capillary fibrinous bronchitis. Williams, in 1883, mentioned the influence of dust, odors, *dampness*, climatic changes and animals; and stated "far more general and intelligible in its action is bronchial inflammation which is the cause of 80 per cent of asthmatic cases."

What then is the relationship? It seems far too frequent to be merely an accidental association. Is it reflex? The absence of reflex paths and the lack of relief from nasal operations would seem to negate this idea. Is it due to a hypersensitiveness (allergic) to the bacteria of the nasal infection? Chandler, Walker, and Rackemann have proposed this solution. The benefit derived from autogenous vaccines gives support to it. But Cooke and Vander Veer have pointed out, correctly I believe, that these bacteria after culture and being made into sterile suspensions do not produce hypersensitive skin reactions, as they should do if they were allergic agents. It seems to me that we must go back to the pathologic changes found by Koessler and Huber in the mucosa of the bronchi in asthmatics—that there is a hyperplasia of the bronchial mucosa sufficient to narrow the lumina of the bronchi and bronchioli very considerably, and that this hyperplasia is dependent upon an actual infection. The infective agent is the nasal secretion, dropping into the back of the

throat and getting past the glottis (in sleep, for instance, when the cough reflex and sensitiveness of the larynx are abolished) and thus infecting the bronchial mucosa.

Treatment based on this idea must contemplate first the removal of the nasal infection if possible or so far as possible. The patient must not be led to expect immediate improvement from this, however. It is not reasonable to hope for it when the bronchial mucosa is so extensively infected and inflamed. This may be treated by vaccines, by iodide of potash, by intravenous sodium iodide and guaiacal carbonate, and by autogenous serum (for the technic of which see below "Nonspecific Methods of Treatment"). The patient may have to be nursed along with ephedrine and epinephrin for relief until the hyperplastic change in the bronchi becomes atrophic.

**III. Allergic Asthma.**—*A. Due to Pollens.*—The asthma of hay fever is one of the most frequent forms. With carefully done cutaneous tests to determine the exact pollens responsible and administration of extracts of the native pollen, beginning several months before the expected attack, the asthma and much of the accompanying hay fever may be avoided in 80 per cent of the cases.

In the middle states the commonest causes of fall hay fever are ragweed, horseweed, pigweed and iva ciliata. The spring type is caused by timothy and orchard grass. The method of prevention of Koessel, popularized by Walker has been found excellent in my hands. An alcoholic extract of the pollen powder is made and given hypodermically in small doses, gradually increased and carried through the first few weeks of the opening of the season.

*B. Due to Food.*—Food is really, in spite of much that has been said, a rare cause of asthma, as it is found clinically. People who have food asthma usually find it out early in life. For instance, I have a patient who has asthma every time he eats a Brazil nut. He discovered this when he was seven years old, and demonstrated it amply to many members of his family. He reacts monstrously to an intradermal test with Brazil nut extract. He never eats Brazil nuts unless he bites into one accidentally when handed a candy made of Brazil nuts, the nut being covered by a layer of chocolate. If he bites into it he immediately spits it out, but the very little he gets on his teeth and tongue are enough to make him uncomfortable for two hours.

This history is typical of most cases of food asthma. The patient tells you the diagnosis. Few obscure clinical cases fall in this category.

*C. Due to Animal Emanations.*—This is an important and rather large class. Horse, dog, rabbit, chicken and goose sensitiveness seem to be the most frequent. Occasionally the outside and the inside of an ani-

mal, e.g., chicken feathers and chicken meat, both occasion allergic symptoms, but my own findings do not agree with those workers who find these conditions frequently.

The stuffing of familiar pillows and mattresses must always be remembered in connection with animal dander hypersensitiveness.

Treatment of this type will depend upon circumstances. It is not always possible to avoid contact with the animal—for instance, if it is horsehair or dog hair—and immunization must be tried. It succeeds in about one out of four cases.

*D. Due to Miscellaneous Causes.*—In this group belong the romantic adventure stories of diagnosis. All sorts of objects must be suspected —orris root, (used in talcum powder and sachets), and glue (the mucilage on the backs of stamps and envelopes), especially Boxwood dust, perfumes, woods, dyes, clothes, ink, typewriter ink, metals, drugs, tooth pastes, soaps, matches, tobaccos, corn plasters, paints, automobile accessories, etc., etc., must all be suspected.

*E. Due to Dust.*—The dust from the patient's room is collected—the remains of vacuum cleaner bag or carpet sweeper—and extracted in ether and used for cutaneous tests. The number of cases which react positively in this way is becoming larger and larger. The substance present in the dust which causes symptoms may be emanations from pillows, mattresses or talcum powders or insect powders, etc.

Cleaning and rearrangement of the patient's sleeping quarters is the proper treatment. In some cases an extract of the dust hypodermically may be more feasible and effective.

*F. Due to Bacteria.*—In most cases of asthma, certainly of recurrent or continuous asthma, there is a definite bronchial infection. Often the onset of asthma dates from such an infection. If the sputum of such cases is plated out, and the colonies separated, and separate vaccines made, skin tests with each bacterial extract will show a positive reaction to one or two of the organisms in a large number of cases. The use of vaccines made with these bacteria is highly effective in certain cases. Some patients are sensitive to colon bacilli; some to the bacteria found in foci of infection.

Rackemann's results with vaccines in asthma cases have been very good. The large New York Clinic of Cooke and Vander Veer are very skeptical of the method. In my own experience it has been very valuable. It must be borne in mind that sensitive patients cannot stand large doses of vaccines; the dosage must be very gradually increased.

**IV. Undiagnosed Cases. Nonspecific Methods of Treatment.**—In a certain number of asthma cases no matter how carefully studied, no conscientiously certain conclusion as to the cause can be reached. Treat-

ment, however, need not be abandoned on this account. The first item in the treatment of such cases is the rearrangement of their daily lives. Removal to a different climate may bring entire relief. If this is not feasible, complete change of living quarters including bedding, pillows, blankets, wallpaper, etc., should be instituted. Removal of infected teeth, tonsils, etc., is frequently of great benefit. Daily affusions of cold water, the patient sitting in a bath tub and the attendant pouring a pitcher or basin of cold water from a considerable height over the shoulders and back, is, as I can strongly testify, often magically beneficial.

The use of the subcutaneous injection of the patient's own defibrinated blood as recommended by Kahm and Emsheimer is a measure which in many cases is unquestionably beneficial. The technic is simple: Twenty-five c.c. of blood is removed from the patient's median basilic vein, and transferred to a sterile bottle or flask containing some sterile glass beads. The blood is gently shaken for ten minutes until defibrinated, filtered through sterile gauze into a sterile medicine glass, taken up in a syringe and injected into the interscapular space. Injections are made once every few days for seven to ten times. If no improvement has occurred after three injections, it is usually useless to continue.

A medical remedy not sufficiently often remembered is iodide of potash. I know two patients who have taken it for years and remained free from asthma which immediately returns if they give it up.

**Summary.**—The causes of asthma are various. The present state of our knowledge makes us consider the basis of the condition to be a particular hypersensitiveness of the bronchial musculature which in most cases is probably hereditary. With this background many causes can initiate the symptom asthma.

In treatment we must keep in mind the fact that the general condition will probably always persist. Once an asthmatic always an asthmatic. But modern investigation has shown that by a careful examination and ferreting out of the causes of each particular case much may be done to relieve them, and by intelligent direction of their lives they may be saved from the serious complications of their condition.

## III. PREVENTION AND TREATMENT OF HAY FEVER

Hay fever is a form of allergy due to sensitiveness of the nasal mucosa and conjunctiva to the pollens of certain plants. In various parts of the country different plants are responsible. Usually the spring type of hay fever is caused by timothy and orchard grass, the fall type by ragweed and the giant form of ragweed, called horseweed. However, it should never be assumed that the patient is sensitive to one of the

common plants, but skin tests with iva ciliata, pigweed, cocklebur, marigold, goldenrod, hemp, rye, blue grass, wheat, cornflower, and some of the common trees should be done in every case.

The prevention of hay fever has been attempted by vaccinating the patient with extracts of the pollen to which he is sensitive. Many clinicians believe that such vaccination is a failure. In all cases where it has been a success the success has been due to scrupulous attention to apparently minute details of technic. This point is worthy of careful emphasis, because disappointment has generally resulted from the haphazard use of indiscriminate vaccines. The elements of success are:

1. The careful determination of the exact pollens to which the patient is allergic.
2. The use of native pollens.
3. The early commencement of the process of vaccination—at least ten weeks before the usual date of attack.
4. The use of fresh pollen extracts.
5. The allowance of an interval of five days between doses of the extract.
6. The use of very small doses at the beginning of treatment.

I wish to emphasize the use of native fresh pollens. By native pollens is meant the use of pollens gathered in the locality of the patient's neighborhood, where he has hay fever. There are a number of preparations of pollen extract put on the market for sale by various drug firms. At times certain of these when given carefully, preseasonally, prevent hay fever in a few patients, but the general results with them are disappointing. This is not surprising. They are made from pollens gathered sometimes in one locality, sometimes from mixed pollens gathered from all parts of the country. A patient may have ragweed hay fever in the eastern part of the United States and move west, even to a locality where ragweed is abundant, and have no hay fever. The manufacturers of the commercial preparations argue that there is a strong family likeness to all the pollens; this is true, but there is just enough difference, apparently, as judged by clinical results, in plants grown under different soil conditions, to make a difference in the pollens and affect adversely their value. Another and even stronger argument against the marketed extracts is the very rapid rate at which all pollen extracts deteriorate. In my own work, pollen extract made in my own laboratory, does not usually remain potent longer than three weeks. To demonstrate this I have repeatedly found that a given dose of a certain pollen extract will cause a marked reaction in a patient:

local swelling, and the general symptoms of coryza, conjunctival redness and itching, even slight asthma. Three weeks later the same dose from the same sample of extract which has simply stood in the ice box, will be practically inert, though an equal amount from a fresh extract will cause again a reaction of the same type as formerly. The period of three weeks hardly represents the time between the completion of manufacture and the arrival of the commercial extracts upon the retail druggist's shelves.

The technic which I use is closely similar to that originated by Koessel and perfected by Walker. I copy Walker's description of it:

"These solutions are made as follows: To 0.5 gm. of the dry pollen is added 44 c.c. of sterile physiologic sodium chloride solution, and the mixture is shaken thoroughly at frequent intervals for twenty-four hours, after which enough absolute alcohol (6 c.c.) is added to the mixture to make the alcoholic content 12 per cent. Again, the mixture is thoroughly shaken at frequent intervals for twenty-four hours, after which it is centrifugalized at high speed and the supernatant fluid is pipetted off and saved. This supernatant fluid, therefore, consists of the pollen protein dissolved in a 12 per cent alcoholic physiologic sodium chloride solution and it represents, by weight, 1 part pollen to 100 parts solvent. This 1:100 solution is used as stock, and from it other dilutions, 1:500, 1:1,000, 1:5,000 and 1:10,000 are made, using a 12 per cent alcoholic, physiologic sodium chloride solution as a diluent. These solutions are used not only for the skin tests, but for treatment, and with the addition of a small crystal of thymol they keep for many months in a cool place.

"*Method of Treating Preseasonally with the Pollen Extracts Follows:* The first treatment consists of from 0.1 to 0.2 c.c. of that dilution next higher than the one which gave a positive skin test, or, in other words, the first dose is 0.1 c.c. or 0.2 c.c. of the strongest dilution which failed to give any skin reaction whatever, no matter how slight. With our pollen extracts the majority of patients whom we treated gave a more or less positive reaction with the 1:5,000 dilution, therefore, the first treatment consisted of 0.1 c.c. or 0.2 c.c. of the 1:10,000 dilution. Treatments were given subcutaneously once a week, and each week the amount of the extract was gradually increased, so that as the treatment progressed, stronger and stronger dilutions were used, until one or more doses of the 1:100 dilutions were given. As an example, I will give what I have found by experimentation to be the best outline of treatment for a patient who gives a more or less positive skin test with a 1:5,000 dilution of pollen extract; 1:10,000, give 0.15 c.c.; 1:5,000 give 0.15 c.c., 0.25 c.c., 0.35 c.c., 0.45 c.c.; 1:1,000, give 0.15 c.c., 0.25 c.c.; 1:500, give 0.15

c.c., 0.25 c.c., 0.35 c.c.; 1:100, give 0.15 c.c., 0.2 c.c., 0.25 c.c. Each dose was given preferably at weekly intervals and never oftener than once every five days.

"This schedule of treatment calls for 14 inoculations. However, for some reason or other, modifications frequently have to be used. An occasional patient is so sensitive to the pollen that a 1:10,000 dilution gives a slight reaction, thus necessitating an initial dose of 0.15 c.c. of 1:20,000 followed by possibly two doses of 1:10,000. Often it happens that a patient has considerable local or general reaction following some one treatment in the schedule, thus necessitating the repetition of that particular dose before the next increase may be given. More often the patient presents himself for treatment too late to complete the scheduled series of treatments before the onset of pollination so that for preseasonal treatment alone, some of the final treatments in the schedule must be omitted. This schedule is often modified purposely with certain individual cases. For instance, in some cases the second treatment with the 1:1,000 dilution, namely, 0.25 c.c., is omitted, and in some cases instead of giving 0.15 c.c. of the 1:100 dilution, when this happens to be the final treatment that the patient is to receive because of onset of pollination, a fifth treatment with the 1:500 dilution, namely, 0.55 c.c., is often substituted, and even a sixth treatment with the 1:500 dilution, namely, 0.65 c.c., is sometimes given. These larger doses of 1:500 approximate the amount of protein in 0.15 and 0.2 c.c. of the 1:100 dilution, therefore, the fifth and sixth treatment with the 1:500 dilution, as outlined, is practically the equivalent of giving 0.15 c.c. and 0.2 c.c. of the 1:100 dilution. Since by far the great majority of patients are treated from three to five times with the 1:500 dilution, and since this number of treatments has given fairly satisfactory results, I consider this number of treatments, which consists usually of a total of ten, as worth giving, although a continuance of the schedule beyond three doses of the 1:500 dilution is most desirable, and giving less than three treatments with the 1:500 dilution is undesirable."

I usually carry the injection through the period of active hay fever. Such patients as have slight symptoms are greatly relieved by these injections of 1 c.c. of the strong extract once a week so long as they have received the preseasonal series of vaccinations. The period of immunization rapidly runs out.

Different experimenters are in close agreement as to the results. In about 80 per cent of all patients marked relief is obtained. In about 6 per cent of patients entire freedom from symptoms is obtained, if the treatment is carried through only one year. (If carried on for three years, Walker had no failures, and from 50 to 100 per cent relief in all

cases.) In 50 per cent of cases, 75 per cent of relief is obtained: asthma is often relieved with the coryza remaining, the duration of the attack is often shortened. In 25 per cent of the cases, 25 to 50 per cent of relief is obtained. Some patients are so sensitive that no large doses can be given them.

Mackenzie and Baldwin have experimented with the application of pollen extract to the nasal mucosa. They feel that they can desensitize the local fixed cells better in this way. The method has proved effective in my hands in combination with the subcutaneous injections of pollen extract.

## IV. SERUM ALLERGY

A number of deaths have been reported from the administration of horse serum containing diphtheria antitoxin, etc.

Attempts have been made to desensitize those patients known (either by previous experience or skin tests) to be sensitive to horse serum by the subcutaneous and intravenous administration of very minute doses of the serum, just as guinea pigs can be protected from anaphylactic shock by the administration of small amounts of serum before the second lethal dose. Friedlander and Runnels have reported that they gave 5 desensitizing doses of serum, amounting to 11.5 c.c. (equivalent to 0.5 c.c. for a guinea pig, an amount which always is sufficient to cause desensitization) but later got symptoms of serum allergy when 100 c.c. of serum were given intravenously. The experience of other clinicians is similar and Coca states that there is "no clear record of a fatal issue in serum allergy having been prevented with the procedure of desensitization." He further states that if the desensitizing method is to have any hope of success, the amount of the initial desensitizing dose must be considerably less than 0.5 c.c.

## V. DRUG ALLERGY

It has been suggested that the peculiar reaction that some individuals give to certain drugs is due to allergy. This explains a number of cases of poisoning from administration of therapeutic amounts of a drug. Aspirin, for instance, is supposed to have a depressant action on the heart: yet every one has known of instances of gigantic doses of aspirin being administered without harm. When analyzed it will usually be found that the instance of "heart depression" under its use occurred with a very small dose, and that the symptoms were cyanosis, rapid pulse and dyspnea: in nine out of fifteen such cases studied by

Cooke a violent asthma occurred. This certainly makes the condition (i.e., the idiosyncrasy) seem to be allergy.

The most frequently used drugs which cause allergy are bromides, iodides, arsenic, quinine, morphine, belladonna, hyoscyamus, iodoform, the salicylates and resins such as turpentine and copaiba.

The symptoms are asthma, skin eruptions, fever, cyanosis, edema, swelling of the joints and changes in pulse rate and blood pressure.

Heran and Saint Girons were able to desensitize a patient to quinine allergy by administering small (0.005 gm.) and gradually increasing doses (0.1, 0.2, 0.4, 0.8, 1 gm.) of it over a period of several days.

## VI. URTICARIA, ANGIONEUROTIC EDEMA, AND ECZEMA

Several forms of skin disease are allergic in origin. Conspicuous among these is the primrose dermatitis. Urticaria, or hives, often accompanies asthma and is a prominent sign in serum reaction. Urticaria arising spontaneously is probably most often due to some form of food allergy—strawberry rash, lobster rash, etc. In many instances, however, the origin is puzzling, and a focal infection from teeth or tonsils may be the nidus of absorption. Walker in urticaria and eczema has found many cases due to pollen allergy, cat hair and all the familiar causes of allergic syndromes elsewhere.

### References

*Hypersensitiveness*

**Auer and Lewis**: Jour. Exper. Med., 1910, xii, 151.
**Coca**: Chapter on Hypersensitiveness in Tice's Practice of Medicine, 1921.
**Otto**: München. med. Wchnschr., 1907, p. 1665.
**Rosenau and Anderson**: Bull. U.S.P.H. and M.H.S. Hyg. Lab., 1908, No. 45.
**Schloss**: Am. Jour. Dis. of Children, June, 1912, xix, 433.
**Talbot**: Boston Med. and Surg. Jour., August 10, 1916.
**Von Pirquet and Schick**: Die Serumkrankheit, 1905.

*Asthma*

Boughton: Jour. Am. Med. Assn., 1912, lxxiii.
Huber and Koessler: The Pathology of Bronchial Asthma, Arch. Int. Med., December, 1922, xxx, No. 6.
Kahm and Emsheimer: Treatment of Bronchial Asthma with Autogenous Defibrinated Blood, Arch. Int. Med., October, 1916.
Kamchorn and Ellis: Pathology of Bronchial Asthma, Am. Jour. Med. Sc., April, 1921, clxi, No. 4.
Miller, W. S.: Musculature of the Finer Divisions of the Bronchial Tree, Am. Rev. Tuberculosis, November, 1921, v, No. 9.
Rackemann: Vaccine Treatment of Asthma, Med. Clin. North America, iv, No. 6.
Vander Veer: Present Status of the Treatment of Hay-fever anl Asthma, Am. Jour. Med. Sc., July, 1922, xvi, No. 1.
Walker: Studies on the Cause and Treatment of Bronchial Asthma, Jour. Am. Med. Assn., August 4, 1917, lxix, No. 5.

### *Hay Fever*

Caulfield: Desensitization of Hay Fever Patients by Injection and Local Application, Jour. Am. Med. Assn., July 8, 1922, lxxix, No. 2.
Koessel: The Treatment of Hay Fever. Forcheimer's Therapeusis of Internal Diseases, New York, 1911, D. Appleton & Co., Vol. v.
Mackenzie and Baldwin: Local Desensitization in Hypersensitive Individuals and Its Bearing on the Prevention of Hay Fever, Arch. Int. Med., December, 1921, xxviii, No. 6.
Rackemann: The Mechanism of Hay Fever, Arch. Int. Med., August, 1922, xxx, No. 2.
Walker, I. Chandler: Frequent Causes and the Treatment of Seasonal Hay Fever, Arch. Int. Med., July, 1921, xxviii, No. 1.
Walker, I. Chandler: Frequent Causes and Treatment of Perennial Hay Fever, Jour Am. Med. Assn., September, 1920, lxxv, No. 12.

### *Drug Allergy*

Cooke: Allergy in Drug Idiosyncrasy, Jour. Am. Med. Assn., September 6, 1915 lxxiii, No. 10.
Heran and Saint Girons: Montpelier Med., 1917, xxxix, 669.

# CHAPTER XVI

# TREATMENT OF DISEASES OF METABOLISM

## THE TREATMENT OF DIABETES MELLITUS

### I. The Principles of Treatment—the Pathology of Diabetes

**A. The Diabetic State.**—The treatment of diabetes is an extremely complex matter and no exact rules can be laid down which will hold in all cases. The basis of all treatment, however, lies in a knowledge of the physiologic changes which occur in the metabolism of the body in diabetes. If the student and practitioner will become familiar with these he will be in a position to work out the problems of the individual case and make his adjustments in accordance. This is a much better scheme than attempting to follow some hard and fast, unchangeable program. We will, therefore, begin by outlining these principles. Unfortunately our knowledge is at times fragmentary and at many points in dispute, but even so we are in possession of a very large body of valuable information.

The only constant difference between metabolism of the normal body and the diabetic is the inability of the diabetic to burn sugars. As a consequence of this other metabolic changes arise in the diabetic organism, but these can be duplicated in other states (e.g., of undernutrition) and are not specific to diabetes. Thus the production of acid-intoxication bodies (acetone bodies, Ketone substances) from the fats, and the changes in the protein metabolism are secondary to lowered glucose utilization.

Carbohydrates are furnished to the body largely in the form of starch, cane sugar and milk sugar. These more or less complex molecules are split up in the intestine and carried to the liver mostly in the form of glucose, levulose, and galactose. In the liver they are converted into a substance called glycogen, or animal starch. This is the principal form of fuel the body uses. As the body tissues need energy the liver supplies it, and in the muscles the glycogen is broken up into glucose and burned, forming water, carbon dioxide and lactic acid in the process. Glycogen is also stored in muscles, and may also become converted into fat, probably in the connective tissues.

The combustion of glucose in the tissues has been the subject of much speculation. Owing to many experiments the pancreas came to be

involved in these considerations. Mering and Minkowski in 1889 reported that total extirpation of the pancreas in dogs led to a severe and fatal diabetes. However if the pancreatic duct is ligated or transplanted so that the secretions pour out on the surface of the body, no diabetes results. Thus it was concluded that the pancreas exerted its influence on glucose metabolism by the elaboration of a substance which is poured into the blood stream. Certain strands of cells known as the islets of Langerhans occur in the pancreas and are different from the acinous or secreting cells. In about 87 per cent of all cases of diabetes these islets of Langerhans have been found to be diseased, the disease ranging from a partial fibrosis to a complete hyaline degeneration. Therefore these islets were supposed to be the source of the internal secretion which activated the combustion of glucose. Upon the subject controversy has raged. Even the existence of the islets of Langerhans as separate entities was doubted; by some histologists they were considered resting stages of the regular acinous cells of the pancreas. However, by injecting vital stains of one color into the blood stream and injecting vital stains of another color into the pancreatic duct, Bensley showed that they were separate entities, that they were not connected by ducts to the rest of the pancreas and that they made up a considerable part of the total volume of the pancreas, and furthermore demonstrated that in the interpretation of histologic findings in this matter the utmost caution must be used in order to pass critical examination. That, in a case of diabetes if "no disease of the islets of Langerhans" is reported, the observer has overlooked the disease by slipshod methods may be considered the conservative viewpoint in the light of careful work.

The actual demonstration of the substance secreted from the islets of Langerhans has recently been made by Banting, Best, Campbell, *et al.* Several such announcements were made, one by Lepine, one by Knowlton and Starling and one by Cohnheim. Each was apparently disproved. Cohnheim, for instance, showed that fresh pancreas extract alone has little effect in destroying sugar, and muscle juice alone no effect, but the two combined have marked glycolytic power. Claus and Embden, working in von Noorden's laboratory, found, however, that if the mixture is kept free from bacteria no glycolysis occurs. Here again all previous work is vitiated by the recent criticisms and experiments of the Toronto group of workers (Best, Banting, Campbell, Macleod, Collip, Fletcher and Noble) who found that researches on the action of pancreatic extracts have hitherto failed to take into account the possible existence of a powerful proteolytic enzyme in fresh pancreas tissue which would digest or destroy any internal secretion also present.

By freezing the total pancreas they managed to isolate a substance to which they gave the name of "insulin" which when injected hypodermically into severe diabetics increased the glucose tolerance and decreased the ketonuria. It is almost unnecessary to point out the revaluation that such studies give to the findings of Cohnheim and his critics.

In diabetes the digestion of starches is unimpaired, and the glycogen forming function of the liver is also intact. Glucose may accumulate in the blood and appear in the urine, then, either (1) because the liver gives up its glycogen stores too rapidly for the tissues to burn them, the excess flowing off in the urine, or (2) because the glucose being brought to the tissues it cannot be burned or broken down from lack of the exciting hormone or enzyme and hence accumulates in the blood and flows off in the urine. The first theory is that elaborated in the endocrine hypothesis of diabetes, if I may so name it, the second that developed by the supposition that the pancreas furnishes an igniting hormone in the tissues which is lacking or inactivated in diabetes.

Woodyatt's simile is in line with modern opinion when he compares the body to a gasoline engine. The glucose is the fuel. The secretion of the islets of Langerhans is the spark. When the spark-plug is dirty combustion does not take place readily and the black smoke or unignited gasoline and carbon comes out of the exhaust. In diabetes sugar in the urine is the black smoke coming from the exhaust.

**B. Different Causes of Glycosuria.**—The amount of glucose normally present in the blood is about 0.08 per cent. It varies somewhat, the normal limits being from 0.07 per cent to 0.12 per cent. When the upper limit is exceeded, the kidneys begin to excrete glucose in the urine.

1. *Renal Glycosuria—Phloridzin Diabetes.*—The kidneys are very sensitive to the excessive concentration of glucose in the blood and in health always throw off excess above the normal. In some cases of nephritis the permeability of the kidney to glucose is diminished and a hyperglycemia results. A contrary condition—of increased permeability of the kidney—occurs as the result of the administration of phloridzin—the so-called phloridzin diabetes, and may perhaps occur spontaneously, a condition to which the name of renal glycosuria or renal diabetes has been given.

Under the administration of phloridzin either subcutaneously or by mouth the urine shows the presence of glucose. As long as the phloridzin is administered this will continue. In experimental animals death will occur as a consequence of extreme loss of sugar. In these animals the amount of sugar in the blood is greatly reduced. The action of the phloridzin therefore seems to be upon the renal epithelium.

A similar condition is supposed to occur in renal glycosuria. Von Noorden in his early lectures denied the existence of this condition. A number of cases have, however, been reported since. They are characterized by the presence of sugar in the urine, by a *hypoglycemia*, by a glycosuria almost entirely independent of carbohydrate intake and by absence of the usual metabolic changes and symptoms of diabetes. Such cases as have been observed over a long period leave the impression that we are after all not quite sure that they are not diabetes of perhaps a strange type, and certainly leave the impression that we are entirely confused as to their real nature.

2. *Alimentary Glycosuria.*—When starches and sugars are taken by mouth and absorption proceeds slowly, almost unlimited amounts can be utilized by the body. But when large amounts of simple sugars are taken into the fasting stomach and absorption occurs rapidly some glycosuria develops. While the amount taken varies with different individuals, roughly 120 grams of glucose is the limit that can be taken in this way without producing glycosuria. This *assimilation limit* is a very important thing to determine in diabetes.

Different starches are not utilized in exactly the same way by the body. This may be due to different rates of absorption or to changes in the reaction of the liver cells. Whatever the explanation, it is certain that some diabetics can utilize certain kinds of starches better than they can others. This is an important principle in treatment as the so-called "oatmeal cures," "rice cure," "potato cure" and "milk cure," depend upon it for their success.

The rôle of the liver in carbohydrate metabolism is of first importance. Nearly all the carbohydrate is carried to the liver and there converted into glycogen (a small part is burned directly and some is converted into fat). The exact mechanism of *glycogenesis* is unknown though we may assume that it is due to an enzyme. An enzyme which splits glycogen in the liver and tissues has been isolated and named glycogenase. Since the action of enzymes is reversible, this same enzyme may cause glycogenesis although experimental work has failed to show this. The liver may store glycogen to the amount of 15 per cent of its total weight. There is some evidence that the liver builds up glycogen more readily with some sugars than with others; Minkowski found that there was an improved carbohydrate metabolism in pancreatic diabetes after the administration of levulose, and many attempts have been made to utilize this idea in human diabetes, in spite of the severe criticism to which it has been subjected.

The breaking up of glycogen, *glycogenalysis*, occurs, as has been said, as the result of an enzyme which is present in the liver and all the

bodily tissues. The origin of this enzyme may be the pancreas. It must be considered as probably different from the glucose-burning enzyme of the pancreas. Attempts have been made to identify diabetes with variations in the amount of glycogenase, but they have all failed. When the liver is removed from the body, glycogenalysis proceeds with great rapidity. It is usually under nervous control, probably largely influenced by the endocrine glands.

3. *Nervous Glycosuria.*—Claude Bernard showed that a puncture of the tip of the calamus scriptorius in the fourth ventricle is followed by a glycosuria which lasts for several hours. It probably occurs through action on the liver, because it is found when the glycosuria ceases, the liver is entirely free from glycogen, and the amount of glycogen in the muscles is considerably reduced. If the experimental animal is starved or exercised so that the glycogen stores of the liver are reduced before the "piqure," glycosuria does not develop. Further explanation of its action lies in the rôle of the ductless glands upon sugar formation.

4. *Endocrine Glycosuria.*—If an injection of epinephrin is given intravenously to a normal animal, glycosuria develops. The amount of glucose found in the urine depends upon the amount of epinephrin given and it continues to be present so long as the epinephrin is present in the blood up to a certain point. After long continued injections or many and frequently repeated injections the glycosuria diminishes or disappears. Hyperglycemia, however, continues. As in the case of "piqure" a diminution of the glycogen reserve of the liver will diminish the amount of glycosuria after epinephrin injections but the result occurs even in starving animals and in pancreatic and human diabetes.

The seat of this action is upon the sympathetic terminals in the liver. Macleod and Pearce were able to cause hyperglycemia by stimulating the splanchnic but no such result was obtained if the adrenals were first removed, or if the liver were denervated.

The pancreas also probably exerts a regulatory action upon the rate at which the liver gives up glycogen to the tissues. This has been referred to above in considering glycogenalysis. This action is, if anything, conservatory and thus the opposite of the action of the adrenals.

Other endocrine glands influence the carbohydrate metabolism. After the administration of thyroid gland or in hyperthyroidism the urine may contain sugar. In hyperthyroidism the administration of large amounts of glucose will result in the appearance of glucose in the urine more promptly and in greater amount than in normal individuals. On the contrary in cases of diminished thyroid secretion, as myxedema, the

organism can store or metabolize very large amounts of sugar. In thyroidectomized dogs the glycosuria action of epinephrin is lost and "piqure" fails to cause glycosuria.

The parathyroids, according to Eppinger, Falta, and Rudinger, have an opposing action to that of the thyroids. If thyroidectomized dogs have the parathyroids removed also, epinephrin injection will cause glycosuria as in normals. These and various other experiments have, it may be noted, not gone without criticism.

The hypophysis, as is well known, has an action similar to the thyroid. Injections of hypophysis extract cause glycosuria, and in various hypophyseal diseases there is a corresponding change in the carbohydrate metabolism, i.e., either glycosuria or increased sugar tolerance. It is considered that the thyroid, parathyroid and hypophysis through internal secretions into the blood stream exert their influence on the pancreas, the thyroid and hypophyseal secretion stimulating the formation of its glycogenolytic enzyme, and the parathyroids retarding it.

This endocrine theory of diabetes has had a marked fascination for some clinicians. It lends itself to speculation and considerable therapeutic experiment. Its defect is the complete lack of anatomical proof. In endocrine disease the glands involved are changed from the normal. But there is no histologic change in the thyroid, the parathyroid, the hypophysis or the adrenals in diabetes. Nor do diabetics exhibit any of the characteristic changes of form or function which patients with thyroid, or hypophyseal disease present.

**C. Changes in Fat and Protein Metabolism in Diabetes.**—1. *Diabetic Acidosis. Diabetic Coma. Fat Metabolism in Diabetes.*—When there is a grave defect of the metabolism of one essential substance, there is likely to be a change in the metabolism of the others. This is particularly true of starch which is the activating fuel of the entire body. In mild cases of diabetes there is little change in protein and fat metabolism, but in severe cases the danger is very grave. The fat metabolism particularly suffers and almost certainly is the origin of the most serious of all diabetic complications—diabetic coma.

"The fats burn in the fire of the carbohydrates," is an often quoted sentence of Rosenfeld's, and may be taken as the text of our sermon.

If an animal is starved for several days there begins to appear in his urine acetone and diacetic acid. Later betaoxybutyric acid also appears. The amount of these bodies which appear in starvation are small compared to the amounts which occur if fats and proteins are eaten but no carbohydrate. These acid bodies also accumulate in the blood, a condition named by Naunyn "acidosis," and lead to symptoms of drowsiness, headache, nausea, and so forth. A fruity odor (of acetone)

appears in the breath, an increased amount of ammonia appears in the urine, and the carbon dioxide tension of the air expired from the lungs is diminished; these are all purely protective phenomena, an attempt on the part of the body to preserve its alkalinity, but may be used as measurements of the degree of acidosis.

If an animal is entirely starved and exercised so that the reserve stores of glycogen in the liver are used up and put upon a fat and protein diet the amount of acidosis is greater than on simple starving alone or on a fat-protein diet alone.

In diabetes of a severe grade when the amount of glucose that can be burned is very low, a similar condition of acidosis may develop, due to the accumulation of acetone, diacetic acid and betaoxybutyric acid and may be more severe in grade than any of the artificially produced examples of acidosis.

The source of the acetone bodies was for some time in dispute. The carbohydrates themselves were first suspected, due, it was thought, to abnormal intestinal decompositions of the starches and sugars. However it was soon shown that the feeding of carbohydrates even in severe cases of diabetes did not increase, but rather tended to decrease the acidosis, so that this theory was abandoned. The proteins next came under suspicion and it was shown that acetone was split off from proteid by treatment with strong acids. But, while undoubtedly the proteins do yield some of the acetone bodies in diabetes, they are not a very important source. Finally it was shown that they are readily formed from fatty acids and that fat is the chief source of betaoxybutyric acid. Each molecule of a higher fatty acid as it is broken down to a lower forms one molecule of betaoxybutyric acid, if the number of carbon atoms in the higher fatty acid is even.

The nature of diabetes acidosis is not essentially different from the acidosis on a carbohydrate free diet. It is, of course, easier for a diabetic to acquire an acidosis because most of the carbohydrate which he eats is not burned anyhow. If a diabetic is allowed to eat enough starch so that glucose appears in the urine, he may really burn enough glucose to diminish or prevent acidosis. This explains the curious anomaly that diabetics are often worse off as soon as treatment begins provided the treatment is not carefully adjusted. The greatest precaution must be taken in the severe cases to allow enough carbohydrate, and to diminish fat intake sufficiently to prevent acetone accumulation.

The natural protections of the body against acidosis are several. As acid begins to accumulate in the blood the normal processes of the body to protect its alkalinity are brought into play. The chief method is by the carbonates and bicarbonates of the blood uniting with the acid and

carrying it to the lungs, it being there eliminated as carbonic acid. In doing this the body's store of alkali is not sensibly depleted. Another method is by way of the kidneys, the kidney excreting the acid phosphates and allowing the base to return to the body for further neutralization. By this method the sodium bicarbonate reserve of the body is renewed. These substances—the carbonates, bicarbonates, etc.,—are known as buffer substances. The exact chemical mechanism by which they act has been worked out with considerable completeness. Those who wish to become acquainted with it in detail are referred to the articles of Henderson, Howland and Palmer given in the bibliography.

2. *Protein Metabolism in Diabetes.*—In severe diabetes when the body's ability to burn the carbohydrates is nearly completely gone, the tissues are suffering from undernutrition just as they would be in carbohydrate starvation. When this state of affairs is reached the body in an attempt to obtain sufficient fuel begins to convert protein into carbohydrate and attempts to burn it. This conversion of protein into sugar is not peculiar to diabetes, but probably occurs to some extent in ordinary protein metabolism. Under any circumstances, even in extreme starvation the body struggles to keep its blood sugar at a constant concentration. Pflüger for many years opposed the idea that sugar could be formed from protein. But towards the end of his life he retracted and indeed became a powerful supporter of the proposition. In severe diabetes it has been shown that the amount of sugar in the urine cannot be accounted for by the amount of carbohydrate ingested alone. If it were possible to convert all the carbon atoms in the protein molecule into sugar, 8 times as much sugar as nitrogen would be formed. This, of course, never occurs, but Lusk showed that in pancreatomized dogs, and in one severe case of diabetes, upon a purely protein diet, the ratio of the amount of dextrose excreted in the urine to the amount of nitrogen excreted—known as the D-N ratio—was 3.65:1. This figure has been criticized by Joslin who feels from his own studies that it is never actually reached in human diabetes and when found probably represents fat interchange as well. "So far as I am aware," he says, "no ratio indicative of complete diabetes (i.e., D:N—3.65:1) exists, unless the patient has recently taken an alkali, usually sodium bicarbonate, or fat. * * * There is no diabetic so severe that he cannot burn some carbohydrate."

The D:N ratio is used largely to measure the severity of the diabetes.

Even more important than this are the studies made recently by Newburgh, Marsh and Holly upon the possibility of establishing protein equilibrium in diabetes. They found in effect, that if too large an amount of protein is not given the severe diabetic, and his glucose intake

comes up to the limit of his tolerance and a large enough amount of fat be given him, nitrogen balance can be established. In other words, it is possible to supply a diabetic with enough protein to supply his protein requirements, so that no protein will be converted into glucose and burned as such. "During the period of starvation," say these authors, "a subject well supplied with body fat burns this fat, and burns no less than he would if fat were given him in his diet. * * * In the case of the fasting lean diabetic, however, who cannot burn glucose, and whose supply of body fat is low, energy and heat are developed almost entirely by the combustion of protein. Destruction of body protein produces glucose exactly as much as does combustion of ingested protein. In the more severe grades of diabetes this is a factor of prime importance. Such patients become sugar free sooner if they are allowed a little carbohydrate and a relatively large amount of fat than they do if starved.

"Protein metabolism above the minimum is undesirable in the diabetic," they conclude, "because of: (1) the great glycogenic property and (2) the large specific dynamic action of protein. Excessive protein metabolism results from a diet containing either too much protein or too few total calories."

## II. The Objects of Treatment and the General Rules of Treatment of Diabetes

In the present state of our knowledge we must say that diabetes is not permanently curable. Once a diabetic always a diabetic. But it is possible to control diabetes for a number of years.

The objects of treatment in diabetes are to keep the patient sugar free, to maintain nutrition and to prevent complications. It is largely a question of working out a metabolic problem in terms of diet.

A most important thing for the diabetic to remember is that if he will keep sugar free his tolerance for sugar will increase. Many patients on being told something of the methods of dietary restrictions in diabetes, state that if they simply throw off the excess sugar in the urine they will eat as much sugar and starch as they like and let the body pass it off. But this idea contains a fallacy, for the presence of hyperglycemia is a distinct menace. To use Woodyatt's simile again, when the body is flooded with sugar it overstimulates the pancreas until it becomes fatigued and no longer "sparks." If the patient will become sugar free, the pancreas will be rested and will improve correspondingly.

**Data Required.**—For intelligent treatment of diabetes it is necessary for the physician to have certain data about his patient. He must know

(1) the amount of sugar in the urine per day compared with (2) the total amount of carbohydrate in the food per day, (3) the patient's weight, and (4) the extent of acidosis.

These four facts are easy for any general practitioner, anywhere, to know and any diabetic can be treated when they are known. It may at times be convenient to know the percentage of blood sugar, but it is not necessary. The best guide to the patient's condition is the amount (or absence) of sugar in the urine. A few mistakes will be made in general practice when blood sugar determinations are not done, but they will be very few and not usually serious. Diabetes may not be preeminently the disease for the general practitioner, but he should not be discouraged from treating it by piling up pompous technical difficulties.

The determination of acidosis may be simply made by testing the urine for diacetic acid, and by the determination of the carbon dioxide content of the alveolar air.

More complicated methods are the determination of the urinary ammonia and the hydrogen-ion concentration of the blood.

**Education of the Diabetic.**—Diabetes cannot be cured without the cooperation of the patient. The chances of success depend often more upon the patient's intelligence and character than upon the extent of the disease.

Every diabetic should buy a set of scales and learn to weigh his food. He should learn the difference between carbohydrates, fats and proteins. He should learn that the most important part of a meal for him is *weight;* the amount rather than the kind of food.

Nearly every diabetic should learn to test his urine for sugar. A few neurotic patients with severe diabetes, who have a very low tolerance and often are not sugar free, may be harmed by this, but usually it is a safe rule.

Every diabetic should have access to a good manual of diabetes designed for patients such as Joslin's or Wilder's.

**General Methods of Treatment.**—

These will be considered under five headings.

1. **Diet.**—The adjustment of diet in diabetes must contemplate four computations; i.e., (1) protein requirement; (2)) carbohydrate tolerance; (3) total caloric requirement; and (4)) the ketogenic-antiketogenic balance.

(1) Protein requirement is given by various practitioners at different figures. Allen allows 1.5 gm. of protein per kilogram of body weight. Newburgh and Marsh allow ⅔ gram of protein, and Wilder 1 gram of protein per kilogram of patient's body weight. The total protein in the

diet will have a certain amount reduced and burned by the body as carbohydrate. Woodyatt gives this as 58 per cent. Individuals probably vary in this metabolic process, and some certainly do not reduce as much as 58 per cent of protein to glucose. No patient reduces more than 58 per cent to glucose, so it can be taken as the maximum figure. However, if a patient is not in nitrogenous equilibrium, he is burning body protein and producing glucose from the glucose fraction of protein.

Children's diets will need to be calculated at a higher figure for the protein requirement, as they require extra protein for growth. It may be put at 2.5 to 3 grams per kilo.

The protein requirement is the cornerstone of diabetic dietary management. After it is determined, the other factors of carbohydrate and fat can be calculated to make up the total daily caloric requirement.

(2) Carbohydrate or glucose tolerance differs in every case. It is determined by putting the patient for several days on an absolutely known and carefully weighed diet in which the total carbohydrate is somewhat above the patient's carbohydrate tolerance, collecting the total twenty-four hour amount of urine, making a quantitative determination of the amount of glucose in a sample of this twenty-four hour specimen, calculating from this the total output of glucose and subtracting the total amount of glucose excreted from the total amount ingested. For instance, if the diet contains 50 grams of carbohydrate, 60 grams of protein, and 80 grams of fat, the total carbohydrate ingested will be all the carbohydrate plus 58 per cent of the protein and 10 per cent of the fat which is 50 + 34 + 8 and the total carbohydrate intake is 92 grams. Then if on such a diet the twenty-four hour amount of urine is 1400 c.c., containing 2 per cent of glucose, the total output will be 28 grams of glucose. The glucose tolerance then will be the total intake, 92 gm., minus the total output, 28 gm., which is 64 grams. Only about 40 per cent of this can be given in the form of pure carbohydrate as allowance must be made for the amount of protein and fat converted by the body to carbohydrate.

Another practice gets the patient sugar-free by starvation or very low diets and then gradually increases the diet, watching the blood sugar until glucose appears in the urine. The point of carbohydrate ingestion just below that at which glucose appears in the urine is the glucose tolerance of the idividual, provided the blood sugar is not at that moment too high.

(3) The total daily caloric requirement is that found in Table VIII in the chapter on Dietetics.

This must be made up of carbohydrate and fat, deducting the caloric contribution of the fixed protein intake, and allowing only enough fat as will maintain a proper ketogenic-antiketogenic balance. This max-

imum cannot be given the patient at once. He must be put upon lower caloric amounts at first and worked up gradually to his maximum, being watched to see if sugar appears in the urine or increases in the blood. If the total caloric requirement cannot be utilized by the diabetic body under your care, insulin must be used.

(4) Ketogenic-antiketogenic balance. There is, as has been shown above, a definite relation between the total glucose burned and the amount of fat that can be burned at the same time. This relationship must be maintained in the diet in order that acidosis and coma may be avoided. The ketogenic fraction is formed by:

90% of fat.
40% of protein (probably less).

Antiketogenic fraction (total glucose) is formed by:

10% of fat (glycerol fraction).
58% of protein (utilized as glucose).
100% of carbohydrate.

Hence, the ketogenic-antiketogenic ratio is:

$$\frac{K}{A} = \frac{0.46P + 0.9F}{0.58P + 0.1F + C}$$

When $\frac{K}{A}$ equals or is less than 1.5 the ketogenic substances can be completely burned and no diacetic acid will appear in the urine. When $\frac{K}{A}$ exceeds 1.5 there is a tendency to ketonemia, ketonuria, acidosis and coma.

A convenient form of the above given ratio when the maximal fat is being given, and the ratio is equal to 1.5, is the following:

$$F = 2C + 0.5P$$

Palmer and Ladd are convinced that the ratio 1.5 is too low for the ketogenic-antiketogenic balance. In actual practice they have found that ratios of 2.5 and even higher, up to 4 are tolerated without evidence of clinical ketosis. Their formula is, therefore, $\frac{2.5\text{-}4}{1}$. Notice the calculations of Strouse given later.

The plans of various clinicians for diet calculation may be reviewed as follows:

**1. The Plan of Newburgh and Marsh.**—Newburgh and Marsh introduced a new conception into treatment. The fundamental principle of the plan is to restrict protein and give a high fat diet. This was always avoided in previous diets because the fats were supposed to cause acid-

osis. However, under the Newburgh and Marsh procedure the authors believe that if enough carbohydrate is given to burn the fat no acidosis results and caloric utilization will be higher than on other plans.

The objections to high protein in the diet appear to be (1) that the protein breaks down into glucose and throws a large amount of sugar into the metabolism (theoretically 58 per cent by weight is possible), (2) that the excess of protein exerts a depressant effect on the ability of the organism to utilize glucose, and (3) because the specific dynamic action of protein is so high that it raises the metabolic rate unduly.

Newburgh and Marsh therefore, after experimentation, allowed ⅔ gram of protein for each kilogram of body weight per twenty-four hours. For a man of 70 kilo. (150 pounds), then, 66 grams (2⅓ oz.) of protein a day is all that is required (contrasting with the 105 grams allowed by Allen).

2. **Woodyatt's Method of Optimal Dietary Calculation.**—Working along the same lines as Newburgh and Marsh with the object of giving the diabetic as many calories as possible, Woodyatt has given out a set of formulas for the purpose of calculating the diet in grams for any given case. He emphasizes what is well known, that in a severe case of diabetes the food carbohydrate is not the only source of carbohydrates, as protein is broken down into carbohydrates, yielding 58 gm. of glucose for every 100 gm. ingested, the fat is likewise catabolized yielding 10 gm. of glucose per 100 gm. of fat. Not only that, but the body will attack its own structures if no food is furnished and catabolize them. The catabolism of protein and fat also produces certain quantities of the higher fatty acids. There is no such thing, therefore, as putting the diabetic to rest so far as metabolism is concerned.

Woodyatt's formula requires the patient's weight in kilograms: he allows 1 gm. of protein for every kilogram of weight (higher than the Newburgh and Marsh but not so high as the Allen allowance). We also require a knowledge of the patient's glucose tolerance. This is calculated by determining the number of grams of glucose passed in twenty-four hours and subtracting this figure from the total amount of glucose metabolized from the patient's food. The carbohydrate in the food is calculated at 100, the protein at 58 per cent of carbohydrate, and the fat at 10 per cent of carbohydrate. For instance, if a patient passes 10 grams of glucose by urine in twenty-four hours, and eats 20 grams of carbohydrate, 150 grams of protein and 100 gm. of fat, his glucose tolerance is 107 grams of glucose: the amount of glucose he ingests is 20 carbohydrate, 87 from protein (0.58 per cent of 150 gm.) and 10 from fat (10 per cent of 100 grams), a total of 117; he passes off 10.

The object of dietary adjustment is to prevent the accumulation of

fatty acids. Neutral fats when eaten are supposed to yield 90 per cent of fatty acids, the protein about 46 per cent. (This figure cannot be accurately measured.) Woodyatt's calculations are based upon the assumption that the fatty acids will be burned completely provided the ratio of fatty acids formed in metabolism and the glucose formed in metabolism is 1.50.

Woodyatt explains his formulae thus:

100 gm. carbohydrate during metabolism yields 100 gm. G and 0 gm. FA.
100 gm. protein during metabolism yields 58 gm. G and 46 gm. FA.
100 gm. fat during metabolism yields 10 gm. G and 90 gm. FA.

"If C = carbohydrate, P = protein, F = fat, G = glucose and FA = higher fatty acids (plus ketogenic amino-acids expressed in terms of higher fatty acid), we may say—as shown above—that the quantity of glucose which any given combination of foods may introduce into the metabolism is expressed by the equation: (1) $G = C + 0.58 + 0.1\ F$ and that the quantity of higher fatty acid (and equivalents) may be expressed as (2) $FA = 0.46P + 0.9F$. When the ratio $\frac{FA}{G}$ exceeds a certain value ketonuria develops. Assuming that this ratio is 1.5, then $\frac{C + 0.58P + 0.1F^{*}}{0.46P + 0.9F} = 1.5$, when the ratio of fatty acids to glucose is as high as it may be without ketonuria. Simplifying this we obtain $F = 2C + 0.54P$, or simply, (3) $F = 2C + \frac{P}{2}$. If it is agreed that the ratio FA:G shall not exceed 1.5 and that the relationships expressed in equations 1 and 2 are given, then to estimate the optimal food combination or diet, one may use equations 1 and 3. Given the quantity of glucose that the patient can utilize completely assign this value of G in equation 1. Thus, if 100 gm. is the highest quantity of glucose derived from all sources that the patient can utilize, 100 gm. = C – 0.58P – 0.1F. In order to secure the maximal number of calories, the diet must clearly contain every possible gram of fat (at 9 calories per gram) that the value of G and the relations expressed in 1 and 3 will permit, and consequently the lowest possible carbohydrate protein fraction (at 4 calories per gram). Also, as between carbohydrate and protein, the protein must be as low as possible and the carbohydrate as high as possible, for 1 gm. carbohydrate yielding 1 gm. glucose and 4 calories provides for the normal oxidation of 1.5 gm. of higher fatty acid. On the other hand, 1 gm. protein having the same caloric value as carbohydrate

*Note: Thus in original article. I think it must be a misprint and the fraction should be reversed.

yields less glucose to support fat combustion and besides this yields acetone itself. If the body weight of the patient be 50 kg. and 1 gm. protein per kg. is selected as a conservative minimum, then P becomes 50 gm. and $F = 2\ C + \frac{P}{2}$ becomes $F = 2\ C + 25$. We have already made $G = 100$ gm. Now the glucose yielded by the 50 gm. protein will be $0.58 \times 50$, or 29 gm., leaving $100 - 29$, or 71 gm., to be distributed between carbohydrate and fat. In other words $C + 0.1\ F = 71$. From this we obtain $F = 710 - 10\ C$. But we also have from the above, $F = 2\ C + 25$. So $2\ C + 25 = 710 - 10\ C$, solving which $C = 57$ gm. (57.08). Substituting this value for C in $F = 2\ C + 25$, we find $F =$ 139 gm. (139.16). Then, the optimal food combination that will fulfil the conditions and relations specified is: carbohydrate, 57 gm.; protein, 50 gm.; fat, 139 gm. = calories, 1, 680."

**3. Oatmeal and Other Special "Cures."**—The principle of these cures is all the same, and is based on the special ability of some diabetics to utilize complex carbohydrates on account of the slow absorption. Reading of respiratory quotients after the ingestion of oatmeal, however, showed that in diabetes there was a very slight utilization of carbohydrate. Von Noorden, who introduced the oatmeal cure, gives this description of the technic:

"The oat cure, as now prescribed by me, consists in the daily administration of 200 to 250 grams of oatmeal, best given in the form of gruel every two hours, and 200 to 300 grams of butter, and often about 100 grams of vegetable proteid or a few eggs may be taken in addition. Otherwise, nothing else is allowed, except black coffee, or tea, lemon juice, good old wine, or a little brandy or whisky. Such a diet is often disliked by the patient, but I have always succeeded in getting over this difficulty. After three or four days upon it the purpose for which it was intended is often found to have been attained: in other cases the same program must be repeated two or three times. It is apparently advisable to precede the oat cure with a few days of restricted diet, or even one or two vegetable days, for when the cure immediately supervenes upon a mixed diet the desired effect follows rather late.

"At the commencement of the oat-cure treatment one notices, it is true, even in the most favorable cases, an increase of the glycosuria; but after a few days the excretion of sugar diminishes and the acetonuria even more so. During the oat days the urine may often be quite free from sugar, and if it is not entirely free, one may be fairly certain that it will be so in the succeeding vegetable days.

"The estimations made (in one case) before the oat cure was begun show plainly enough that it is a case of severe glycosuria combined with

excessive acetonuria. With the most restricted diet it had not been possible to bring the sugar below 40 grams; even on vegetable days more than 20 grams were excreted. In the course of the oatmeal treatment the urine became free from sugar, and it remained so on the subsequent return to the restricted diet. It even appeared that small quantities of carbohydrate could be well tolerated, whereas for several months previously there had been no question of such a thing.

"There are only relatively few cases in which the result is quite so surprisingly beneficial; in many others it is incomplete, although still satisfactory; in others again no result at all is obtained. The following fact is noteworthy: cases in which the results of the treatment were most beneficial relate without exception to the very severe forms of glycosuria; many of them were in children or young people. On the other hand, the result was almost without exception a failure in cases of slight glycosuria, the exact opposite of what *a priori* had been expected. The oat cure rendered me immense service in severe cases, and I may even say that I have often succeeded in fending off incipient coma by its use."

*Green Days.*—Green vegetable days, when the patient eats nothing but green vegetables, were also suggested by von Noorden. They are very useful. Patients will accept them better than fasting days, though they are in reality little more than fasting days.

4. **Strouse's Calculations.**—The following simple procedure for balancing the diabetic diet is proposed:

(1) Protein equals 0.66 gm. per kilogram of body weight, or 0.3 gm. per pound.

(2) Carbohydrate equals the glucose tolerance minus 58 per cent of the protein.

(3) Fat should furnish enough calories to equal the basal caloric needs minus the calories supplied by protein and carbohydrate.

(4) The amount of fat must be within limits which will prevent the development of ketonuria =

$$\frac{\text{2.5-4 gm. of fat}}{\text{1 gm. of available carbohydrate}}$$

## Diabetic Diet Lists

Inasmuch as many practitioners experience difficulty in calculating diabetic diets, a list, varying in nature, is appended. All the plans given below have been tried out clinically by dependable experts.

A. Low Fat Diets.—Six in number, increasing in caloric value. Each represents the total twenty-four hour food intake.

Calories — 500

| | | |
|---|---|---|
| Carbohydrates | 30 | gm. |
| Protein | 45 | gm. |
| Fat | 20 | gm. |

| | GRAMS | OUNCES | HOUSEHOLD MEASURE |
|---|---|---|---|
| 5% Green Vegetables | 600 gm. | 20 oz. | 12 htsf.* |
| 3 Eggs, boiled | | | |
| Black Coffee | 540 c.c. | 18 oz. | 3 cups |
| Chicken Broth | 720 c.c. | 24 oz. | 4 cups |
| White Meat Chicken | 60 gm. | 2 oz. | |

The coffee and chicken broth may be given without allowing any caloric value to them, if the broth is strained free of fat. They are useful on these low caloric diets to keep the patient from being hungry.

## Diet II

Calories — 800

| | | |
|---|---|---|
| Carbohydrates | 40 | gm. |
| Protein | 67 | gm. |
| Fat | 28 | gm. |

| | GRAMS | OUNCES | HOUSEHOLD MEASURE |
|---|---|---|---|
| 5% Green Vegetables | 800 gm. | 27 oz. | 16 htsf. |
| White Meat Chicken | 120 gm. | 4 oz. | |
| Plain Boiled Fish | 120 gm. | 4 oz. | |
| 2 Eggs, boiled | | | |
| Coffee and Broth as in No. I Diet. | | | |

## Diet III

Calories — 1015

| | | |
|---|---|---|
| Carbohydrates | 45 | gm. |
| Protein | 86 | gm. |
| Fat | 37 | gm. |

| | GRAMS | OUNCES | HOUSEHOLD MEASURE |
|---|---|---|---|
| 5% Vegetables | 900 gm. | 30 oz. | 18 htsf. |
| 4 Eggs | | | |
| White Meat Chicken | 180 gm. | 6 oz. | |
| Plain Boiled Fish | 120 gm. | 4 oz. | |
| Lister's Bread | 30 gm. | 1 oz. | |
| Broth and Coffee as in Diet No. 1. | | | |

## Diet IV

Calories — 1200

| | | |
|---|---|---|
| Carbohydrates | 50 | gm. |
| Protein | 110 | gm. |
| Fat | 60 | gm. |

| | GRAMS | OUNCES | HOUSEHOLD MEASURE |
|---|---|---|---|
| 5% Green Vegetables | 900 gm. | 30 oz. | 18 htsf. |
| Coffee — 3 cups with 1 teasp. of cream in each. | | | |
| Chicken or Lamb Chop | 240 gm. | 8 oz. | |
| 4 Eggs | | | |
| Fish | 240 gm. | 8 oz. | |
| Gluten Bread | 6 gm. | 1/5 oz. | |
| Broth as in Diet No. I. | | | |

*Heaping Tablespoonful.

DIET V

Calories — 1500

Carbohydrates ------------- 75 gm.
Protein ------------------ 125 gm.
Fat ---------------------- 80 gm.

| | GRAMS | OUNCES | HOUSEHOLD MEASURE |
|---|---|---|---|
| 10% Green Vegetables | 50 gm. | 1.4 oz. | 1 htsf. |
| 5% Green Vegetables | 900 gm. | 30 oz. | 18 htsf. |
| Chicken, Lamb Chop or Steak | 240 gm. | 8 oz. | |
| Fish | 240 gm. | 8 oz. | |
| Coffee with 1 teasp. cream in each | 540 gm. | 18 oz. | 3 cups |
| Chicken Broth | 720 c.c. | 24 oz. | 4 cups |
| Bacon | 60 gm. | 2 oz. | |
| Cream Cheese | 60 gm. | 2 oz. | |
| Lister's Bread | 60 gm. | 2 oz. | |
| Gluten Bread | 30 gm. | 1 oz. | |

DIET VI

Calories — 2000

Carbohydrates ------------- 100 gm.
Protein ------------------ 140 gm.
Fat ---------------------- 110 gm.

| | GRAMS | OUNCES | HOUSEHOLD MEASURE |
|---|---|---|---|
| Grape Fruit | 350 gm. | 11 oz. | ½ average grape-fruit |
| 5% Green Vegetables | 900 gm. | 30 oz. | 18 htsf. |
| 10% Green Vegetables | 150 gm. | 5 oz. | 3 htsf. |
| Chicken, Steak, Chops or rare Beef | 240 gm. | 8 oz. | |
| Fish | 240 gm. | 8 oz. | |
| Eggs 2 - 4 | | | |
| Gluten Bread | 30 gm. | 1 oz. | |
| Lister's Bread | 60 gm. | 2 oz. | |
| Bacon | 60 gm. | 2 oz. | |
| Cream Cheese | 60 gm. | 2 oz. | |
| Coffee with cream | | | 3 cups |
| Butter | 30 gm. | 1 oz. | |

B. HIGH FAT DIETS. (AFTER MCHENRY AND COOPER.)—Four diets increasing in caloric values.

DIET I.

Calories — 870

Carbohydrates -------------- 30 gm.
Protein -------------------- 30 gm.
Fat ------------------------ 70 gm.

| FOOD | AMOUNT | CARB. | PROT. | FAT |
|---|---|---|---|---|
| Vegetables, 5% | 350 gm. | 10.5 | 3.5 | --- |
| Butter | 30 gm. | --- | --- | 25 |
| Cream, 20% | 120 gm. | 4.8 | 2.4 | 24 |
| Grapefruit | 100 gm. | 5 | 1 | --- |
| Egg | 1 gm. | --- | 6 | 6 |
| Orange | 100 gm. | 10 | 1 | --- |
| D-Zerta Jello | 1 serv. | --- | 2 | --- |
| Meat, (cooked | 45 gm. | --- | 12 | 7.5 |
| Bacon, (Cooked) | 15 gm. | --- | 2.5 | 7.5 |
| Total | | 30.3 | 40.4 | 70.0 |

Breakfast:
- Orange—100 grams
- Bacon—15 grams
- Cellu or bran wafers—butter 10 grams
- Coffee—saccharine—cream 40 grams

Dinner:
- Broth
- Meat—45 grams
- 5%vegetables—200 grams
  - cauliflower 100 grams, string beans 100 grams
- D-Zerta Jello.
- Cellu wafers—butter 10 grams
- Tea—saccharine—cream 40 grams

Supper:
- Egg 1.
- Spinach 100 grams
- Celery hearts 50 grams
- Grapefruit—100 grams
- Cellu—or bran wafers—butter 10 grams
- Tea—saccharine—cream 40 grams

### Diet II

Calories — 1546

Carbohydrates ............ 52 gm.
Protein ............ 51 gm.
Fat ............ 126 gm.

| FOOD | AMOUNT | CARB. | PROT. | FAT |
|---|---|---|---|---|
| Vegetables, 5% | 600 gm. | 18 | 6 | --- |
| Oatmeal (uncooked) | 15 gm. | 10 | 2.5 | 1 |
| Grapefruit | 100 gm. | 5 | 1 | --- |
| Orange | 100 gm. | 10 | 1 | --- |
| Eggs | 2 | -- | 12 | 12 |
| Butter | 60 gm. | -- | ---- | 50 |
| Cream, 20% | | | | |
| Meat (cooked) | 90 gm. | -- | 24 | 15 |
| Total | | 52.6 | 51.3 | 126 |

Breakfast:
- Oatmeal—15 grams
- Eggs 2
- Cream—120 grams
- Butter—15 grams
- Cellu wafers—coffee—saccharine

Dinner:
- Clear broth
- Meat—50 grams
- 5% vegetables—300 grams—(cabbage 150 grams)
  - (escalloped tomatoes—150 grams)
- Grapefruit—100 grams
- Cellu wafers or bran cakes
- Butter—25 grams
- Cream—60 grams. Tea—saccharine

Supper:
- Cold meat—40 grams
- 5% vegetables—300 grams (as follows):
  - Salad—Head lettuce—50 grams
    - Asparagus—100 grams
    - String beans—100 grams
    - Celery hearts—50 grams
- Diabetic Mayonnaise
- Orange—100 grams
- Butter—20 grams; cream—60 grams
- Cellu wafers—tea—saccharine

### Diet III

Calories — 1907

| | |
|---|---|
| Carbohydrates | 98 gm. |
| Protein | 75 gm. |
| Fat | 135 gm. |

| FOOD | AMOUNT | CARB. | PROT. | FAT |
|---|---|---|---|---|
| Oatmeal (uncooked) | 30 gm. | 20 | 5 | 2 |
| Eggs | 2 | ---- | 12 | 12 |
| Bacon (cooked) | 30 gm. | ---- | 5 | 15 |
| Diaprotein bran muffin | 2 | ---- | 11.8 | 3.6 |
| Butter | 45 gm. | ---- | ---- | 37 |
| Cream, 20% | 240 gm. | 9.6 | 4.8 | 48 |
| Vegetables, 5% | 600 gm. | 18 | 6 | ---- |
| Orange | 100 gm. | 10 | 1 | ---- |
| Apple | 100 gm. | 15 | 1 | ---- |
| Meat (cooked)) | 90 gm. | ---- | 24 | 15 |
| Cellu pumpkin pie | ⅙ pie | 3 | 2 | 3 |
| Wholewheat bread | 50 gm. | 22 | 3 | ---- |
| Total | | 97.6 | 75.6 | 135.6 |

Breakfast:

Orange—100 grams
Oatmeal—30 grams
Eggs 2
Bacon—30 grams
Cream—120 grams
Butter—10 grams
Diaprotein bran muffin 1
Coffee—saccharine

Dinner:

Clear broth
Roast beef—50 grams
5% vegetables—300 grams:
(spinach 150 gms., String beans 150 gms.)
Cellu pumpkin pie—1 serving
Wholewheat bread—25 grams.
Tea—saccharine

Supper:

Cold meat—40 grams
Fried eggplant—150 grams
Head lettuce—50 grams
Sliced tomato—100 grams
Baked apple—100 grams
Cream—60 grams; butter—15 grams
Diaprotein bran muffin 1; wholewheat bread—25 grams
Tea—saccharine

### Diet IV

Calories — 2309

| | |
|---|---|
| Carbohydrates | 135 gm. |
| Protein | 80 gm. |
| Fat | 170 gm. |

| FOOD | AMOUNT | CARB. | PROT. | FAT |
|---|---|---|---|---|
| Oatmeal (uncooked) | 30 gm. | 20 | 5 | 2 |
| Bacon (cooked) | 30 gm. | ---- | 5 | 15 |
| Eggs | 3 | ---- | 18 | 18 |
| Salmon (canned) | 50 gm. | ---- | 11 | 6.5 |
| Vegetables, 5% | 300 gm. | 9 | 3 | ---- |
| Vegetables, 10% | 200 gm. | 12 | 2 | ---- |
| Butter | 45 gm. | ---- | ---- | 37 |
| Meat (cooked) | 60 gm. | ---- | 16 | 10 |
| Fruit, 10% | 100 gm. | 10 | 1 | ---- |
| Nut Charlotte | 1 serv. | 6 | 6 | 34 |
| Potatoes (cooked) | 120 gm. | 24 | 2.4 | ---- |
| Wholewheat bread | 100 gm. | 45 | 6 | ---- |
| Cream, 20% | 240 gm. | 9.6 | 4.8 | 48 |
| Total | | 135.6 | 80.2 | 170.5 |

Breakfast:
- Oatmeal—30 grams
- Eggs 2
- Bacon—30 grams
- Cream—120 grams
- Butter—10 grams
- Wholewheat bread toasted—40 grams
- Coffee—saccharine

Dinner:
- Clear soup
- Meat—60 grams
- Potato—120 grams
- 5% vegetable—150 grams (cabbage)
- 10% vegetable—100 grams (minced carrots)
- Nut Charlotte—1 serving
- Cream—60 grams
- Butter—20 grams
- Wholewheat bread—30 grams
- Tea—saccharine

Supper:
- Salad as follows:
  - Salmon—50 grams
  - 1 hard cooked egg
  - Head lettuce—50 grams
  - Minced beets—100 grams
  - Asparagus—100 grams
- Diabetic mayonnaise
- Strawberries—100 grams
- Wholewheat bread—30 grams; bran or cellu wafers
- Cream—60 grams
- Butter—15 grams
- Tea—saccharine

C. Jonas-Musser Diets. (See references.)

| | FOOD QUANTITIES FOR NORMAL WEIGHT OF LB. | PROTEIN PER LB. GM. | CALORIES PER LB. GM. | KETOGENIC-ANTIKETOGENIC RATIO |
|---|---|---|---|---|
| No. 1 as given | 100 | 0.5 | 7 | 1.2 |
| No. 1 max. fat | 100 | 0.5 | 9 | 1.5 |
| No. 2 as given | 100 | 0.5 | 14 | 1.3 |
| No. 2 max. fat | 100 | 0.5 | 17 | 1.5 |
| No. 3 as given | 100 | 0.5 | 19 | 1.3 |
| No. 3 max. fat | 100 | 0.5 | 22 | 1.5 |
| No. 4 as given | 100 | 0.5 | 25 | 1.3 |
| No. 4 max. fat | 100 | 0.5 | 28 | 1.5 |
| No. 5 as given | 100 | 0.5 | 11 | 0.2 |
| No. 6 as given | 100 | 0.5 | 11 | 0.1 |

*Diets.*—The following diets are for a person weighing 100 pounds.

Numbering is purely arbitrary and has no relation to the order in which the diets should be given. It is particularly important to note that the severe cases should be started on Diet No. 6.

Increase or decrease the meat so that the patient receives 0.5 gm. per pound of body weight. Patients admitted with a glucosuria but without diacetic acid are placed on Diet No. 1. Increase the diet as guided by urine examinations.

The quantity of vegetables in each diet is relatively low, so that 10 or 15 gm. of carbohydrate may be added to the diet as vegetables without making too great a bulk. If it is desired to add more than this amount, use the next higher diet.

Fat may be increased up to maximum mentioned in each diet and still be within the safe range of ketogenic-antiketogenic ratio.

DIET I

| | | P | F | C |
|---|---|---|---|---|
| Breakfast: | | | | |
| Grapefruit | 150 gm. | 0.6 | ---- | 5.7 |
| Eggs | 2 | 13.2 | 12.0 | |
| Coffee | | | | |
| Non-COH biscuit | 2 | | | |
| | | 14.0 | 12.0 | 5.7 |
| Dinner: | | | | |
| Broth | 150 c.c. | 3.5 | | |
| Lean meat | 100 gm. | 23.0 | 28.6 | |
| Vegetables, 5 per cent | 100 gm. | 0.5 | | 4.0 |
| Vegetables, 10 per cent | 100 gm. | 0.5 | | 8.0 |
| Tea or coffee | | | | |
| Non-COH biscuit | 2 | | | |
| | | 27.5 | 28.6 | 12.0 |
| Supper: | | | | |
| Egg with lettuce as salad | 1 | 6.5 | 6.0 | |
| Coffee | | | | |
| Oatmeal | 50 gm. | 1.4 | 0.2 | 5.8 |
| Non-COH biscuit | 2 | | | |
| Total | | 49.0 | 46.0 | 23.0 |

Total calories, 700.

Maximum fat permitted when urine is sugar-free, 70 gm.

If the patient does not become sugar-free, place on Diet 2 and use insulin. See details of Insulin Treatment.

DIET II

| | | P | F | C |
|---|---|---|---|---|
| Breakfast: | | | | |
| Grapefruit | 150 gm. | 0.6 | | 5.7 |
| Egg | 1 | 6.5 | 6.0 | |
| Oatmeal | 100 gm. | 2.8 | | 11.5 |
| Butter | 15 gm. | | 12.7 | |
| Cream | 20 c.c. | 0.6 | 5.0 | 1.0 |
| Coffee | | | | |
| Non-COH biscuit | 2 | | | |
| | | 10.5 | 23.7 | 18.2 |
| Dinner: | | | | |
| Broth | 150 c.c. | 3.5 | | |
| Meat | 100 gm. | 23.0 | 28.0 | |
| Vegetables, 10 per cent | 100 gm. | 1.0 | | 8.0 |
| Vegetables, 15 per cent | 100 gm. | 1.0 | | 12.0 |
| Cream, 20 per cent | 15 c.c. | 1.6 | 3.0 | 1.2 |
| Butter | 15 gm. | | 12.7 | |
| Tea or coffee | | | | |
| Non-COH biscuit | 2 | | | |
| | | 30.1 | 43.7 | 21.2 |

| | | P | F | C |
|---|---|---|---|---|
| Supper: | | | | |
| Eggs | 2 | 13.2 | 12.0 | |
| Bacon | 15 gm. | 0.7 | 9.0 | |
| Vegetables, 10 per cent | 100 gm. | 1.0 | | 8.0 |
| Vegetables, 5 per cent | 100 gm. | 1.0 | | 3.0 |
| Butter | 15 gm. | | 12.7 | |
| Cream, 20 per cent | 15 c.c. | 0.6 | 3.0 | 1.2 |
| Non-COH biscuit | 2 | | | |
| | | 16.5 | 36.7 | 12.2 |
| Total | | 57.1 | 104.8 | 51.6 |

Total calories, 1370.

Maximum fat permitted 130 gm.

When higher amounts of carbohydrates are desired work up to Diet 3.

### Diet III

| | | P | F | C |
|---|---|---|---|---|
| Breakfast: | | | | |
| Grapefruit | 150 gm. | 0.6 | | 5.7 |
| Egg | 1 | 6.5 | 6.0 | |
| Oatmeal | 150 gm. | 4.7 | | 16.0 |
| Butter | 30 gm. | | 25.5 | |
| Cream, 20 per cent | 40 c.c. | 1.2 | 8.0 | 2.0 |
| Non-COH biscuit | 2 | | | |
| | | 13.0 | 39.5 | 23.7 |
| Dinner: | | | | |
| Broth | 150 c.c. | 3.5 | | |
| Meat | 90 gm. | 20.7 | 25.2 | |
| Vegetables (potato) | 100 gm. | 2.0 | | 20.0 |
| Vegetables, 15 per cent | 100 gm. | 1.0 | | 12.0 |
| Vegetables, 10 per cent | 100 gm. | 1.0 | | 8.0 |
| Cream, 20 per cent | 40 c.c. | 1.2 | 8.0 | 2.0 |
| Butter | 30 gm. | | 25.4 | |
| Tea or coffee | | | | |
| Non-COH biscuit | 2 | | | |
| | | 29.4 | 58.6 | 42.0 |
| Supper: | | | | |
| Eggs | 2 | 13.2 | 12.0 | |
| Bacon | 30 gm. | 1.4 | 18.0 | |
| Vegetables, 5 per cent | 100 gm. | 1.0 | | 3.0 |
| Butter | 30 gm. | | 25.2 | |
| Cream, 20 per cent | 15 c.c. | 0.6 | 3.0 | 1.2 |
| Fruit or berries | 50 gm. | | | 8.0 |
| Coffee | | | | |
| Non-COH biscuit | 2 | | | |
| | | 16.2 | 58.2 | 12.2 |
| Total | | 58.6 | 156.3 | 77.9 |

Total calories, 1950.

Maximum fat permitted, 184 gm.

If patients remain sugar-free on this diet, insulin may not be necessary; if sugar occasionally appears or blood sugar is high, small doses of insulin may be desirable.

Diet IV

| Breakfast: | | P | F | C |
|---|---|---|---|---|
| Grapefruit | 150 gm. | 0.6 | 0.1 | 5.7 |
| Egg | 1 | 6.5 | 6.0 | |
| Oatmeal | 150 gm. | 4.7 | | 16.0 |
| Butter | 30 gm. | | 25.4 | |
| Cream, 20 per cent | 60 c.c. | 1.8 | 12.0 | 3.0 |
| Bacon | 30 gm. | 1.4 | 18.0 | |
| Tea or coffee | | | | |
| Non-COH biscuit | 2 | | | |
| | | 15.0 | 61.5 | 24.7 |
| **Dinner:** | | | | |
| Meat | 90 gm. | 20.7 | 25.2 | |
| Potatoes | 75 gm. | 1.5 | | 15.0 |
| Vegetables, 10 per cent | 100 gm. | 1.0 | | 8.0 |
| Vegetables, 15 per cent | 100 gm. | 1.0 | | 12.0 |
| Vegetables, 5 per cent | 100 gm. | 1.0 | | 3.0 |
| Cream, 20 per cent | 60 c.c. | 1.8 | 12.0 | 3.0 |
| Butter | 50 gm. | | 42.5 | |
| Olive oil (in dressing) | 20 c.c. | | 20.0 | |
| Fruit or berries up to 15 per cent group | 100 gm. | 1.0 | | 15.0 |
| Tea or coffee | | | | |
| Non-COH biscuit | 2 | | | |
| | | 28.0 | 99.7 | 56.0 |
| **Supper:** | | | | |
| Eggs | 2 | 13.2 | 12.0 | |
| Rice | 75 gm. | 2.1 | | 18.0 |
| Cream | 60 c.c. | 1.8 | 12.0 | 3.0 |
| Butter | 20 gm. | | 17.0 | |
| Tea or coffee | | | | |
| Non-COH biscuit | 2 | | | |
| | | 17.1 | 41.0 | 21.0 |
| Total | | 60.1 | 202.2 | 101.7 |

Total calories, 2470

Maximum fat permitted, 240 gm.

If sugar-free on this diet, insulin is not indicated.

Diet V

| Breakfast: | | P | F | C |
|---|---|---|---|---|
| Grapefruit | 150 gm. | 0.6 | | 5.7 |
| Oatmeal | 150 gm. | 4.7 | | 16.0 |
| Egg | 1 | 6.5 | 6.0 | |
| Milk | 50 c.c. | 1.5 | 2.0 | 2.5 |
| Tea or coffee | | | | |
| Non-COH biscuit | 2 | | | |
| | | 13.3 | 8.0 | 24.2 |
| **Dinner:** | | | | |
| Broth | 150 c.c. | 3.5 | | |
| Meat | 90 gm. | 20.7 | 25.2 | |
| Rice | 100 gm. | 2.8 | | 24.0 |
| Potatoes | 100 gm. | 2.0 | | 20.0 |
| Vegetables, 10 per cent | 150 gm. | 1.0 | | 12.0 |
| Milk | 50 c.c. | 1.5 | 2.0 | 2.5 |
| Tea or coffee | | | | |
| Non-COH biscuit | 2 | | | |
| | | 31.5 | 27.2 | 58.5 |

| | | P | F | C |
|---|---|---|---|---|
| Supper: | | | | |
| Egg | 1 | 6.5 | 6.0 | |
| Rice | 150 gm. | 4.2 | | 36.0 |
| Milk | 50 c.c. | 1.5 | 2.0 | 2.5 |
| Tea or coffee | | | | |
| Non-COH biscuit | 2 | | | |
| | | 12.2 | 8.0 | 38.5 |
| Total | | 57.0 | 43.2 | 121.2 |

Total calories, 1100.

Cases with ketonuria and glucosuria, but with a normal or nearly normal reaction of blood, give insulin as detailed under Insulin Treatment.

### Diet VI

| | | P | F | C |
|---|---|---|---|---|
| Breakfast: | | | | |
| Orange | 150 gm. | | | 10.0 |
| Oatmeal | 200 gm. | 6.5 | | 22.0 |
| Milk | 50 c.c. | 1.5 | 2.0 | 2.5 |
| Coffee | | | | |
| | | 8.0 | 2.0 | 34.5 |
| 10:30 A.M.: | | | | |
| Oatmeal | 200 gm. | 6.5 | | 22.0 |
| Dinner: | | | | |
| Broth | 150 c.c. | 3.5 | | |
| Potato | 100 gm. | 2.0 | | 20.0 |
| Rice | 200 gm. | 5.6 | | 48.0 |
| Milk | 50 c.c. | 1.5 | 2.0 | 2.5 |
| Coffee | | | | |
| | | 12.6 | 2.0 | 70.5 |
| 3:30 P.M.: | | | | |
| Oatmeal | 200 gm. | 6.5 | | 22.0 |
| Supper: | | | | |
| Oatmeal | 200 gm. | 6.5 | | 22.0 |
| Milk | 50 c.c. | 1.5 | 2.0 | 2.5 |
| Coffee | | | | |
| | | 8.0 | 2.0 | 24.5 |
| 10:00 P.M.: | | | | |
| Toast | 25 gm. | 4.0 | 0.5 | 15.0 |
| 1:00 A.M.: | | | | |
| Toast | 25 gm. | 4.0 | 0.5 | 15.0 |
| 4:00 A.M.: | | | | |
| Toast | 25 gm. | 4.0 | 0.5 | 15.0 |
| | | 12.0 | 1.5 | 45.0 |
| Total | | 53.6 | 7.5 | 218.5 |

Total calories, 1150.

A severe case with marked ketonuria, glucosuria and a shifting of the blood to the acid side. Cases rapidly approaching coma. Give insulin as detailed under Insulin Treatment.

D. For patients who experience difficulty in calculating diets, the following ingenious card devised by R. D. Lawrence is recommended. (See references.)

THE "LINE-RATION" DIET SCHEME.—

Any Left half-Line added to any Right half-Line = one ration.

| Left Half-Lines (5 gm. C.) | oz. | Right Half-Lines ($7\frac{1}{2}$ gm. P., 15 gm. F.) |
|---|---|---|
| Milk | $3\frac{1}{2}$ | One egg and fat $\frac{2}{5}$ oz. |
| xBread | $\frac{1}{3}$ | Bacon 1 oz. |
| xOatmeal (raw) or biscuit | $\frac{1}{4}$ | Ham 1 oz. and fat $\frac{1}{4}$ oz. |
| Cabbage or greens | $5\frac{1}{2}$ | Kipper $1\frac{1}{2}$ oz. and fat $\frac{1}{2}$ oz. |
| Tomato (raw or cooked) | 4 | Herring 1 oz. and fat $\frac{1}{2}$ oz. |
| xPotato or banana (skinned) | $\frac{3}{4}$ | Lean meat or mutton 1 oz. and fat $\frac{1}{2}$ oz. |
| Cauliflower or French beans | 6 | Lean lamb or veal 1 oz. and fat $\frac{1}{2}$ oz. |
| Brussels sprouts | 5 | Lean Pork 1 oz. and Fat $\frac{1}{2}$ oz. |
| Spinach, asparagus or parsnips | 6 | Chicken or Duck 1 oz. and Fat $\frac{1}{2}$ oz. |
| Turnip or carrot | 4 | Tongue (tinned) 1 oz. and Fat $\frac{1}{4}$ oz. |
| Onions, leeks or marrow | $3\frac{1}{2}$ | Liver 1 oz. and Fat $\frac{1}{2}$ oz. |
| Beetroot | $2\frac{3}{4}$ | Kidney or Tripe $1\frac{1}{4}$ oz and Fat $\frac{1}{2}$ oz. |
| Lettuce (raw | 6 | Rabbit $\frac{2}{3}$ oz. and Fat $\frac{1}{2}$ oz. |
| Cucumber (raw) or cress | 5 | Cheese $\frac{3}{4}$ oz. and Fat $\frac{1}{8}$ oz. . |
| Celery (raw) | 5 | White Fish $1\frac{1}{4}$ oz. and Fat $\frac{3}{5}$ oz.. |
| xApple, pear or raspberries (raw) | $1\frac{1}{2}$ | Sardines 1 oz. and Fat $\frac{1}{4}$ oz. |
| Orange or Strawberries | 2 | Salmon 1 oz. and Fat $\frac{2}{5}$ oz. |
| Rhubarb (stewed) | 6 | Crab or Lobster $1\frac{1}{2}$ oz and Fat $\frac{3}{5}$ oz. |
| Apples, pears or cherries (stewed) | $2\frac{1}{2}$ | Pheasant, Grouse, Partridge $\frac{3}{4}$ oz. and Fat $\frac{1}{2}$ oz. |

xArticles x-ed to be taken only if specially allowed by physician.

Fats are Meat Fats, Suet, Dripping, Butter, Margarine, Olive Oil; Thick Cream in twice the amount.

| Doctor's Prescription:— | Date 13/4/25 | Insulin | Extras |
|---|---|---|---|
| Rations per day: | 10 | | |
| Breakfast: | 3 | 12 | |
| Dinner: | 2 | | |
| Tea: | 1 | | |
| Supper: | 4 | 8 | |

Additional Instructions:

Instructions to Patients

Your doctor will prescribe a certain number of rations a day. One ration is one complete Line. Any Left half-Line can be added to any Right half-Line to make one ration; but two Left half-Lines or two Right half-Lines must not be combined to make a ration. Thus equal numbers of Lefts and Rights must be taken together. Suppose you are allowed 3 rations for breakfast, i.e. 3 complete Lines, you can take $3\frac{1}{2}$ oz. milk, $\frac{1}{2}$ oz. bread and 4 oz. tomatoes, making 3 Left half-Lines, and 1 egg and $\frac{2}{5}$ oz. of Fat as butter, and 2 oz. bacon, making 3 Right half-Lines, one of which has been taken twice, i.e., the bacon.

All foods are to be weighed cooked, except the fats and articles marked *raw*. Accurate weighing on a confectioner's or other suitable scale is essential. Weights of from 4 to $\frac{1}{4}$ oz. are required, $\frac{1}{5}$ oz. equals a new halfpenny, $\frac{1}{3}$ oz. equals a new penny. A measuring glass for fluids is also required. Vegetables to be mashed if solid and

boiled thoroughly, not steamed. No flour or sugar to be used in cooking. Saccharine may be used for sweetening. The making of bran biscuits and other extras of no food value, the use of flavorings, etc., is described more fully in "Food Tables" by Harrison and Lawrence, published by Skinner & Co., Denmark Hill, S.E. 5, or obtainable from Lewis & Co., Gower Street.

If you are taking insulin, *never* stop it without your doctor's orders. If you are ill, go to bed and send for your doctor.

*Explanation to Doctors.*—Each ration or Line = 5 gm. carbohydrate (Left), 7½ gm. protein and 15 gm. fat (right). Each ration or Line has a calorific value of 190 calories. To calculate the number of rations to be prescribed per day, divide the naked weight in pounds by 16.5, e.g., 165 pounds requires 10 rations. Divide the rations as desired between the various meals of the day, i.e., 3 for breakfast, 3 for dinner and so on. This gives a basal diet of 25 calories per kilogram of body weight (about 11 calories per pound). This is a good starting point, and if the patient is not sugar-free after a week, he will require insulin. If the patient is losing weight and energy, more ample diets of 30, 35, and 40 calories per kilogram can be calculated by dividing the weight in pounds by 13.5, 11.8 or 10.3 respectively to obtain the correct number of rations. If the carbohydrate tolerance proves high, extra Left half-Lines can be added, and eventually qualitative restriction may be found sufficient to control the disease. If acidosis is severe the fats can be cut out.

*Details of the Line-Ration Scheme.*—The proportions of C., P., F., in Woodyatt's formula have been used in arranging the scheme. Each Line contains 5 gm. C. (Left), 7½ gm. P., and 15 gm. F. (Right), and is equivalent to 190 calories. One way of prescribing the correct number of Lines is to divide the total calories required by 190. Another and simpler way is merely to weigh the patient and divide the weight by the factors given in Table XXIII. To those who wish to understand the reason of this, the following explanation is given: We are giving 1 gm. P. for every kilogram of body weight, and, therefore, can look upon the protein as the fixed point in the scheme. For every gram of P. provided by a line 0.66 gm. of C. and 2 gm. F. (in all equivalent to 25 calories) are also provided. Therefore, whenever we give 1 gm. P. per kilogram of body weight we are at the same time giving 25 calories per kilogram as long as the proportion of C., P., F., in the Line is observed. We can easily calculate the number of Lines to provide 1 gm. P. per kilogram of body weight, for since each Line contains 7.5 gm. P., the number of Lines to contain 1 gm. P. and 25 calories per kilogram of body weight is obtained by dividing the body weight in kilograms by 7.5 (or the weight in pounds by 16.5, because 7.5 kilogram = 16.5 pounds). To take a simple example, if we wish to give a man weighing 75 kg. (165 lbs.) a diet of 25 calories per kilogram, we divide 75 by the factor 7.5

and obtain the answer of ten Lines per day. These ten Lines contain 50 C., 75 P., 150 F., equivalent to 1,900 calories which, divided by his weight in kg. 75 = 25 calories per kilogram of body weight.

TABLE XXIII.—FACTORS FOR THE LINE-RATION SCHEME

| To obtain number of Lines containing | Divide weight in kilograms by | or divide weight in pounds by |
|---|---|---|
| 20 Calories per kilogram | 9.5 | 20.8 |
| 25 Calories per kilogram | 7.5 | 16.5 |
| 30 Calories per kilogram | 6.2 | 13.5 |
| 35 Calories per kilogram | 5.3 | 11.8 |
| 40 Calories per kilogram | 4.7 | 10.3 |
| 50 Calories per kilogram | 3.8 | 8.3 |
| 60 Calories per kilogram | 3.1 | 6.8 |
| 70 Calories per kilogram | 2.7 | 5.9 |
| 80 Calories per kilogram | 2.4 | 5.2 |
| 100 Calories per kilogram | 1.9 | 4.2 |

Divide the naked weight in kilograms or pounds by the factors in the second or third columns to obtain the number of Lines which contain 20 to 100 calories per kilogram by body weight.

The correct number of Lines can also be calculated by dividing the total number of calories required by 190, which is the calorific value of one Line.

E. HEIGHT-WEIGHT TABLES.

Tables of average weights will be useful (Tables XXIV and XXV).

TABLE XXIV

NORMAL HEIGHT AND WEIGHT TABLES

Normal weight for height in children (without clothes)

| *Height* Feet | Inches | *Weight* Boys | Girls |
|---|---|---|---|
| 2 | 3 | 18.7 | 18.3 |
| 2 | 6 | 22.9 | 21.8 |
| 3 | 0 | 30.6 | 30.5 |
| 3 | 6 | 41.0 | 40.0 |
| 4 | 0 | 53.0 | 51.0 |
| 4 | 6 | 70.0 | 68.0 |
| 5 | 0 | 93.0 | 100.0 |

Heights and weights of men (weight with clothes; height with shoes)
Feet and Inches

| Age | 5–0 | 5–6 | 6–0 | 6–5 |
|---|---|---|---|---|
| 15 | 107 | 126 | 152 | 177 |
| 20 | 117 | 136 | 161 | 186 |
| 30 | 126 | 144 | 172 | 201 |
| 40 | 131 | 149 | 180 | 212 |
| 55 | 135 | 155 | 184 | 219 |

Women

| Age | 4–8 | 5–0 | 5–6 | 6–0 |
|---|---|---|---|---|
| 15 | 101 | 107 | 126 | 152 |
| 20 | 106 | 114 | 132 | 156 |
| 30 | 112 | 120 | 138 | 161 |
| 40 | 119 | 127 | 146 | 167 |
| 55 | 125 | 133 | 153 | 177 |

F. Joslin's Table of 5%, 10%, 15%, and 20% Vegetables.

Table XXV

Food Table. Arranged According to Percentage of Carbohydrate

| 5% | 10% | 15% | 20% |
|---|---|---|---|
| Lettuce | Pumpkin | Green peas | Potatoes |
| Cucumbers | Turnip | Artichokes | Shell beans |
| Spinach | Kohl-rabi | Parsnips | Baked beans |
| Rhubarb | Squash | Canned lima beans | Green corn |
| Endive | Beets | | Boiled rice |
| Marrow | Carrots | | Boiled macaroni |
| Sorrel | Onions | | |
| Sauerkraut | Mushrooms | | |
| Beet greens | | | |
| Dandelion | | | |
| Celery | | | |
| Tomatoes | | | |
| Brussels sprouts | | | |
| Water cress | | | |
| Sea kale | | | |
| Okra | | | |
| Cauliflower | | | |
| Egg plant | | | |
| Cabbage | | | |
| Radishes | | | |
| Leeks | | | |
| String beans | | | |

2. **Insulin.**—Insulin is the extract of the islets of Langerhans. When injected subcutaneously in an animal, it reduces blood sugar. It simultaneously reduces acidosis or ketosis, when such exists in the presence of hyperglycemia. It is ineffective when taken by mouth. It is measured in units. One unit will burn from 1 to 4 grams of carbohydrate. Individuals vary in regard to the amount of carbohydrate a unit of insulin will burn in their organisms. The average is 2 gm. and may be used as a basis for insulin dosage calculations.

It exerts its effects within a few minutes and its effect passes off in about two hours. It should thus be given about 15 minutes before a meal.

It causes an immediate lowering of the blood sugar. This, if the amount of sugar is lowered too much, produces a definite train of symptoms. The American manufacturers give the following description of the symptoms and treatment of overdosage:

"The one danger to be avoided in the administration of this very potent extract is the production of hypoglycemia—the lowering of the blood sugar below the normal level (100 mg. per 100 c.c. or 0.10 per cent).

"This may be avoided on the physician's part by a very careful balancing of the diet against the dosage of insulin employed and on the patient's part by a close and intelligent observance of the diet together with a thorough understanding of the premonitory or warning symptoms of a beginning hypoglycemic reaction and the steps necessary to prevent its further development.

"These symptoms will now be enumerated:

(1) Sudden and pronounced hunger.
Sudden weakness or fatigue.
A peculiar restlessness or nervousness, often described by the patient as a feeling of 'inward trembling.'
Pallor or flushing of the face; dilated pupils.
Increased pulse rate (of diagnostic value in children)

"These early symptoms may be made to disappear quickly and further danger avoided, if the patient will immediately eat a little carbohydrate such as two or three lumps of sugar or candy, the juice of an orange, a slice of bread, some crackers, half a glass of milk or a teaspoonful of syrup.

"If the overdose is sufficiently large and the above corrective measures are not adopted, then the following train of symptoms, all or in part, will follow:

(2) Sweating. (This is the most characteristic symptom).
Tremor and incoordination of muscles.
Anxiety, fear, apprehension, excitement and emotional disturbance.

(3) Aphasia, disorientation, delirium, confusion.

(4) Convulsions, collapse.
Low blood pressure, low body temperature.
Unconsciousness.

(5) Exitus lethalis.

"Treatment of Hypoglycemia. This consists of the administration of carbohydrate in some form and in the early stages it makes little difference what kind of carbohydrate food is given. Should the more serious symptoms develop, then orange juice with added sugar, or ordinary syrup but better still glucose or corn syrup should be given by mouth—one tablespoonful of any corn syrup diluted with water and this repeated at the end of fifteen minutes if improvement is not noted. If the patient cannot swallow, the diluted syrup may be given by stomach or nasal tube. As a last resort 10 to 20 grams or more of glucose must be given intravenously, using for this purpose a sterile 10 to 50 per cent solution of pure glucose (dextrose)."

In severe cases, in juvenile diabetes and in the complications the action of insulin is magical. No other word can describe the results in those cases which we have been fumbling with by the older methods of treatment

Few people had ever seen a human being in diabetic coma recover until the introduction of insulin. Now such cases are common. In coma the dosage is large.

In the mild cases it is best to try to get along without insulin and keep the patient within his carbohydrate tolerance.

3. **Synthaline, Neosynthaline, Myrtillin, etc.**—The great disadvantage of insulin is that it must be administered hypodermically. When the patient is under the necessity of taking a subcutaneous injection before every meal and is faced with the prospect of going on railroad trips and living in hotels and carrying all his paraphernalia with him, the hope of exchanging such a drug for one which can be taken by mouth is certainly welcome. Attempts to produce a glucose reducing substance which can be used by mouth are therefore very much in order.

Synthaline is a guanidine derivative (deka diguanidine). Guanidine has the two pharmacologic properties of lowering blood pressure and reducing blood sugar. Synthaline does not have so much effect on blood pressure and has 100 times as much glucose reducing power as guanidine. One milligram of synthaline will reduce 1.2 grains of sugar. This action is apparently due to actual glucose oxidation in the tissues. Neosynthaline, a later synthetic production, is less toxic to the liver cells than synthaline. These substances are taken by mouth. They do not reduce blood sugar in every case of diabetes; there is no way to determine beforehand which case will respond, but the mild arteriosclerotic types seem to be most benefited.

Myrtillin is the product of blueberry leaf and has been advocated by Allen as a substance which if taken by mouth will reduce blood sugar. It is not so dependable or constant in its action as synthaline.

None of these substances will reduce acidosis or are to be tried in coma.

4. **Exercise** is usually beneficial. In most cases it helps to burn up carbohydrate. Some severe diabetics are made worse by it, apparently because it exhausts the glycogen reserve of the liver.

5. **Drugs.**—Drugs have little place in its treatment. *Opium* in the form of the powdered leaf may "squeeze the last grains of sugar out of the urine" of a severe case. *Aspirin* has been used in the same way. *Sodium bicarbonate* is used to counteract the acidosis.

There is no particular contraindication for any drug in diabetes provided its use is desirable for symptomatic treatment. *Ether* and *chloroform* are badly tolerated in severe cases and very likely to bring a coma. The sugar content of mixtures containing simple syrup, etc., should always be considered.

6. **Removal of Focal Infections** is of little value and should be undertaken only for the very best of reasons. Joslin records the death of a patient following teeth extraction under anesthesia. This, however, is

rare. The care of the teeth should be given attention regularly by conservative measures.

### III. Treatment of Mild Cases of Diabetes

There is nothing in therapeutics more generally satisfactory than the treatment of the mild diabetic. These patients are usually past middle age, from fifty-five years to seventy years, and their diabetes is probably dependent upon arteriosclerotic changes in the islets of Langerhans, never resulting in complete destruction and leaving a considerable glucose tolerance. If the patient will give up sweets, sugar, large amounts of bread and other starches he will live many years in complete freedom from symptoms and more than average dietary comfort.

The first step is to render him sugar free. This is usually easy and in the mild diabetic may be accomplished by putting him at starvation for a few days. This method was introduced into practice by Allen and has come to be known as the Allen method. Because of the fear of bringing on acidosis by starvation there was long a fear that starvation was a dangerous thing for the diabetic. Allen showed that this fear was groundless but upon the contrary that acidosis, if present, was improved. Starvation will usually render the patient sugar-free, depending upon the severity of the case, in from two to five days. During the starvation period the patient may have as much water as he wishes, and a cup of black coffee three times a day, with some whiskey to control the appetite. In the severe diabetic it should not be kept up too long and does not always work as well in the severe as with the mild and moderate cases.

The best food to give in the first few days after starvation is green 5 per cent vegetables. The diet list devised by Joslin is useful to give the patient. Eggs, cream, meat, bacon, nuts and fruit may be added gradually, until total caloric requirement is satisfied, always remembering the danger of a high fat diet,* and always remembering that sudden changes of diet are bad for many diabetics.

When the patient has been sugar free for some time the carbohydrates may gradually be added. As time goes on the amount of food of this kind that can be consumed by some diabetics is astonishing. Bread in limited quantities, once or twice a day, vegetables of all kinds, and even desserts may be taken without glycosuria.

A weekly green day when only green vegetables are given is a useful procedure. A monthly starvation day is beneficial, bringing up the

*I refer here to the mild diabetic; this has no relation to the procedure of Newburgh and Marsh.

tolerance amazingly, particularly if it is subject to a falling rate between such starvation days.

Every such patient should learn to examine his own urine and to weigh his food. Every such patient will benefit from a full knowledge of the nature of the disease.

### IV. Treatment of Severe Cases of Diabetes

The central problem of diabetes is the treatment of the severe case of diabetes. A severe case of diabetes seems to be almost a different disease from a mild case. The patient's glucose tolerance is very low, he is always on the verge of acidosis, and he breaks down protein to form glucose. There is, of course, every graduation between the mild and the severe case—moderate, moderately severe, etc. The plans of treatment outlined above for the mild and here for the severe case may be juggled by the practitioner to fit the intermediate cases.

It is immediately obvious when one begins to study the methods used that the severe diabetic should be placed for the preliminary period of his treatment in a hospital. The hospital should be one with especially trained nurses or a dietitian who is familiar with the dietetic technic of diabetes.

The most important question for the clinician to settle is the relative rôles of dietary adjustment and insulin dosage in treating the individual case. Theoretically this is very simple: the diet is calculated according to the figures given above, and the patient's daily protein, carbohydrate, and fat ratios are prescribed keeping in mind the protein requirement, the glucose tolerance, the caloric requirement and the ketogenic-antiketogenic balance: if the glucose tolerance is so low that the caloric requirements cannot be satisfied then carbohydrate and fat are added and insulin is administered subcutaneously at the dose of 1 unit for every 2 gm. of carbohydrate added to the diet, 15-30 minutes before each meal. In practice, however, the matter is somewhat more complex. In the first place the various calculations mentioned, while they must be known and understood by the clinician, have wide variations when applied to different individuals. For instance, all individuals do not convert protein to glucose at the ratio of 58 to 100, the ketogenic-antiketogenic balance is considered at such different points as 1.5, 1.8, and 2.5 to 4, by equally competent investigators, and finally insulin varies per unit in its glucose-oxidation power from 1 gm. to 4 gm. in different individuals and even in the same individual under different circumstances. Thus every severe diabetic becomes a dietetic experiment and his needs must be discovered by the method of trial and error.

The temperament of the patient and the temperament of the clinician are both factors in the final choice of this adjustment. Some patients like to be on a diet; they enjoy weighing and working out their food ratios; they are very conscientious about obeying orders and very scrupulous about the rules of the game; they become imbued with the notion that if they ever step over their instructions their doom will be upon them. Other patients are happy-go-lucky; they are always breaking diet rules; they enjoy the table; they regard their doctor as a pleasant but fussy old party, and the treatment degenerates into a game in which the patient is trying to cheat the doctor and the doctor trying to detect and foil the patient. Clinicians, likewise, are divided into metabolists and humanists. The metabolists work out the formulae to the last decimal; they are conducting an exact metabolic experiment. The humanists rather enjoy trying to give their patients enough to eat. In the pre-insulin days the metabolists were conducting the proceedings; since the introduction of insulin it has been found that it is possible to keep patients sugar-free, comfortable—not hungry—and at normal weight, and with these powers the humanists have a little the better of it. It would be best for the metabolists always to have the first class of patients and the humanists to have the second, but this does not work out in practice and as a consequence we frequently see a humanist patient sullenly sweating under the rule of a metabolist doctor, and a metabolist patient bewilderedly spinning along under the jovial encouragement of a humanist doctor.

The consensus of the best advice we have at the present time seems to be that it is better for the diabetic to get along on the lowest diet possible for him and take very small doses of insulin. But there are some dissenting voices. Sansum has advocated a high carbohydrate diet (2 gm. to each gram of fat), and enough insulin, even if this is up to 80 units a day. Other clinicians, especially those who labored so hard with their diabetic patients in the pre-insulin days, still have the shadow of those starvation diets upon them and speak of insulin as if it were a deadly poison to be given in 1, 2 and 3 unit doses.

Certain patients of whom I know, who were very poor patients under dietary restriction, have been paying no attention whatever to the weighing out of food, but religiously take a hypodermic of a good dose of insulin before lunch and dinner—from 10 to 25 units as the case may be. One of them has been doing this for five years—ever since insulin was distributed for experimental purposes. She is a very severe diabetic who was always resentful of any dietary restriction. She fell into the habit of using insulin without dietary adjustment against advice. She maintains a little more than her normal weight, has gradually reduced rather than increased her dosage of insulin, has no clinical ketosis, and

is very active. I have seen her in insulin shock a dozen times—sweating, trembling, tachycardia—not because I was called to see her, but because I was a guest at her table. I have repeated her story to a number of diabetic specialists who are very much alarmed about her, say she will die suddenly, and shake dubious heads. When I conscientiously repeat these observations to her she replies, like the famous colored boy—"just laughs—that's all." Nothing anybody can say has any influence on her, so I have decided, instead of trying to teach her anything, to try to learn something from her.

### V. Treatment of Complications

**1. Coma.**—The use of insulin will certainly supplant all other methods in the treatment of diabetic coma. It is truly life saving, and to those who have seen the futility of treatment by any other means, magical. A young man was brought into the hospital at 7 P.M. in complete coma. At 7:45 he was given fifty units of insulin. His blood sugar had dropped a hundred points in two hours. He was then given another dose and in the early morning another one. By noon the next day he was sitting up in bed, talking to his family with a satisfactory blood-sugar level and all evidences of acidosis gone. Such cases as this are some of the great triumphs of modern medicine. The dosage of insulin in these cases is high—50 to 150 units in twenty-four hours.

The treatment of coma—impending or actual—is the subcutaneous injection of insulin and the administration of large amounts of fluid. The subcutaneous injection of insulin is better than the intravenous, as by the latter method a great deal is evacuated by the kidneys before it does any good. The initial dosage should be 20 units every half hour for two or three doses. Saline hypodermoclysis, or proctoclysis, or water by mouth, if the patient is wide awake enough to swallow, should be given at the same time. If any more insulin is given, glucose solution intravenously, or by mouth, should accompany it unless the blood sugar is still very high. Some clinicians give large amounts of glucose solution with the first dose of insulin.

The prevention of impending coma is not impossible by other methods. The methods of treatment that have been employed are: (1) the administration of alkali, usually sodium bicarbonate, (2) the administration of substances which will aid in the combustion of acid bodies, and (3) the rest-heat-liquid-no-alkali treatment of Joslin.

Sodium bicarbonate may be given by mouth, by rectum or intravenously. No especial technic need be detailed for the first two methods. The solution for intravenous administration should be in the strength of 3 per cent. About 1500 c.c. are usually given. The solution must not be boiled after solution is made as sodium carbonate is formed. If

a sterile spoon is put into a hitherto unopened Squibb's package of sodium bicarbonate, and a quantity removed and weighed in a sterile watch glass, and these placed in the sterile salt solution, this will be sterile.

Glucose solution intravenously 5 per cent to 10 per cent or by rectum in order to burn the fatty acid bodies by the combustion of sugar is a classical form of treatment. The administration of other such substances in impending coma is often used.

Joslin has described a plan which has been very successful in his hands in impending coma. He entirely avoids the use of alkalies as in practice he has found them dangerous and useless. He puts the patient to bed, with a trained nurse in attendance, keeps the body warm with flannel next the skin if necessary, gives 1000 c.c. of liquid (hot water, coffee, tea, thin broths) in each six hours until the danger is over (if fluid cannot be taken by mouth it is given by rectum) and unless the patient has been fasting, in which case the fast is continued, he is given 1 gram of carbohydrate per kilo of body weight. Digitalis and caffeine are given for circulatory stimulation.

**2. Diabetic Gangrene.**—Diabetic gangrene occurs, nearly always, as the result of the combination of arteriosclerosis and diabetes. It is quite similar pathologically to like conditions without diabetes. Hyperglycemia seems to have a rather bad influence in arteriosclerosis, and such conditions. Buerger even found in the obliterating endarteritis he describes in young male Russian Jews a hyperglycemia.

Such patients with diabetes and arteriosclerosis with any tendency to circulatory disturbances in the lower extremities should endeavor to prevent gangrene by scrupulously favoring the member. They should not impede circulation in the legs by the position they are placed in, should not let them rest dependent over the edge of a chair but should use a footstool, and should take short walks.

When the gangrene has actually occurred, the surgeon should be called in and operation promptly done. I should always prefer nitrous oxide as the anesthetic, and should not change the patient's dietary before operation. Insulin has been found useful in some such cases.

**3. Furunculosis and Carbuncles** also are surgical complications. They should be treated promptly just as if the patient were not a diabetic. If furunculosis is recurrent, the patient should be advised to wash the whole body twice a day with soap and water and dry the skin without rubbing.

**4. Operations upon Diabetics.**—I quote as a text the wise words of Addis:

"There are three dangers which are commonly accepted as accompanying operations on diabetic patients—wound infection, nonhealing,

and diabetic coma. The method of preparation for operation still frequently followed is the removal of sugar and starches from the food. The theoretic basis of this treatment is the conception that the slowness of healing of the operation wound and its liability to infection are to be ascribed to the direct action of the excessive amount of sugar in the blood and tissues, and that diabetic coma is especially likely to occur in those patients in whom the diabetic condition, as judged by the amount of sugar excretion, is especially pronounced. An endeavor is therefore made to get rid of the hyperglycemia before operation, and the patient is given a carbohydrate-free diet until the sugar in the urine is eliminated or has been greatly reduced in amount.

"This method of preparation does not attain its object. Unfortunately it is not simply ineffectual, it is positively disastrous in its results. It is the best way possible to subject the patient to the maximum degree of risk. Yet the theory on which it is based seems plausible enough; indeed it is the first obvious hypothesis which anyone could probably make. This is, as a matter of fact, exactly what it is. It is a pure hypothesis, unsupported by any experimental work. Investigators have long ago put it to the test and found it wanting. They have published their results in technical journals, and have gone on to make other hypotheses and other experiments. In the meantime many clinicians, concerned more with practice than with theory, continue to act on the not unnatural assumption that since a reduction of the amount of carbohydrate in the food is one of the standard principles of treatment in diabetes, it is all the more necessary to carry it out rigorously as a preparation for operation, when the patient is going to be in danger according to the intensity and the grade of the diabetic condition from which he suffers."

In general the fear of infection and the fear of nonhealing are groundless. The real danger of operations on diabetics is the bringing on of coma. Joslin states that if an operation is necessary, the existence of diabetes is no reason for its nonperformance. Such a statement could be made only by a man who had treated his cases very skilfully and had brought them to the operating table in the very best of condition. In general medical practice operations upon diabetics are attended with a mortality that is little short of frightful. Why should it be so? Why should coma be so much more common in diabetics who are operated upon than in those who are not operated upon? It is not due to tissue trauma; it occurs in minor operations with little tissue trauma as well as major ones. It is not due entirely to the anesthetic; it occurs in operations in which no anesthetic is used—(although chloroform and

ether have a special danger). Induction of coma occurs from psychic trauma, or from an accident, a fracture, etc. It is due, I believe, to the sudden increase of adrenal secretion which occurs in these conditions with the consequent exhaustion of the glycogen reserve of the liver. The feeding of carbohydrates and glucose as a preliminary to a surgical procedure which has been found beneficial by several surgeons, is therefore indicated and is a well grounded practice.

No operation on a diabetic should be done, my experience at least has convinced me, unless it is an operation of absolute necessity. The discomforts of such things as gallstones and hemorrhoids should be borne indefinitely by the diabetic rather than submit to the dangers of surgical interference.

If operation is decided upon, the anesthetic of choice is nitrous-oxide-oxygen; chloroform is absolutely contraindicated and ether should be given only under strong necessity. The operation should be concluded in as short a time as possible. No change should be made in the patient's diet before operation unless it be to give oatmeal or glucose so as to augment the glycogen supply of the liver.

5. **Diabetes and Nephritis.**—The consultant is frequently called to see a case of combined diabetes and nephritis, the attending physician being in doubt because of a theoretical impression that the diets of the two diseases are contradictory—the diabetes requiring a protein diet and the nephritis contraindicating it. It may be said in general that with any complication of diabetes, the diabetes is the disease which must receive first consideration. If the diabetes is well treated the other condition will do much better than if a hyperglycemia were present. The type of nephritis usually present is an arteriosclerotic form, both the nephritis and the diabetes probably being dependent upon arteriosclerotic changes. In these cases, the diabetes usually being mild, the diet can be satisfactorily adjusted. The prognosis is the ordinary prognosis of the nephritic.

6. **Diabetes and Tuberculosis.**—Untreated diabetes seems to dispose towards tuberculosis. Joslin's statistics would seem to indicate that it was more frequent during the time when the treatment of the cases was less satisfactory, fewer cases of tuberculosis occurring during his later series.

The combination is not a happy one and the tuberculosis usually makes rapid progress. Recovery is not, however, impossible. The details of treatment must be adjusted with great tact. The treatment of the diabetes must always be paramount. Outdoor life and rest are however not incompatible with good diabetic treatment.

**7. Diabetes and Pregnancy.**—Glycosuria in pregnancy and the puerperium does not mean diabetes under all circumstances as galactose frequently makes its appearance in the urine of pregnant women and nursing mothers.

If diabetes actually exists, the pregnancy should, in my opinion, be terminated unless most exceptional circumstances are present. The treatment of a diabetic pregnant woman is no different than that of other diabetics. The prognosis is much more favorable if the diabetes is discovered for the first time after the pregnancy has begun than if pregnancy occurred in a patient with established diabetes.

**8. Juvenile Diabetes.**—Diabetes in children is a very serious disease. The average duration of life after onset is less than two years. At the same time it is to be remembered that every case of cure of diabetes which has been reported has been in a child.

The treatment must be along the same lines as the treatment of the severe case. The protein requirement of children is, however, higher than in the adult, Joslin puts it at 3 grams per kilo. Children stand dietary restriction fairly well. They should particularly be watched for the consumption of candy and other forms of sweets.

Insulin must be used with children. It should be remembered that in children recovery from diabetes is not impossible and we may expect that when they are carried along for a time on insulin the islets of Langerhans may regenerate and its use may be discontinued. In the preinsulin days, such children died before regeneration could take place.

## OBESITY

### I. Importance of Instituting Treatment. The Metabolism of Obesity

The dangers of obesity have been emphasized very widely. Life insurance companies find that applicants weighing 20 per cent above the average for their height and age have a much higher death rate than the normals. The younger the overweight the better the mortality; overweights below the age of thirty have an average death rate. The cause of death in overweights older than thirty is in a striking proportion of instances an indication of arterial disease and cardiovascular hypertension—apoplexy, angina, heart failure, dropsy, diabetes.

Most writers on the subject, with curious naiveté, regard the obesity as the cause of these disorders. They issue solemn warnings about getting fat, basing these admonitions on the supposition that if obesity occurs, diabetes and high blood pressure will follow in its wake. There is no question of the association, but that obesity *causes* diabetes or hypertension, is a childishly uncritical attitude to assume. Why should obesity cause high blood pressure? There is no logical answer. We see

thin people who have high blood pressure, and fat people who have low blood pressure. If obesity were an operating *cause* of high blood pressure the latter simply could not happen. If obesity is an operating *cause* of high blood pressure, the fatter a person becomes the higher his blood pressure will be—which is not true. The fact is that hypertension and arteriosclerosis are caused by entirely separate factors from overweight. We do not know all of them, but heredity is certainly one. Obesity is also an hereditary condition. And it so happens that in the science of genetics it is well known that certain hereditary factors tend to become linked, which is the situation with obesity and hypertensive cardiovascular disease. Diabetes of a certain kind—that occurring in overweights, and that occurring in individuals past thirty years of age—is due to arteriosclerosis of the islets of Langerhans—(63 per cent of diabetics below the age of thirty were of normal weight or below, 83 per cent of diabetics over thirty were overweight).

The metabolism of obesity has been the subject of a good deal of work. Setting aside the cases plainly of endocrine origin, the constitutional obese individual has a basal metabolism which is within the expectancy for his weight, height, and age. Strouse's studies are of great value. They indicate that the metabolism of the fat person does not react in a normal manner to the various foodstuffs. People maintain their weights doggedly almost irregardless of their food intake. Strouse produces two striking instances at opposite metabolic poles:

Case 1.—A young woman, aged 30. Height—165 cm. Weight 86.8 kg. She had a food scale, and was practiced in calculating diets from experience in taking care of her diabetic mother. She consented to undertake a dietetic experiment and, from September 2 to January 12, maintained a daily caloric intake which was seldom over and usually under 1200 calories. In the meantime she was at "hard labor." A good part of the time her daily caloric intake was around 500 calories. She entered the experience weighing 86.8 kg. and at its termination weighed 85.6 kg.

Case 2.—A thin, healthy man, aged 39. Height—175 cm. Weight—52 kg. His usual life was active with good appetite and a full balanced food ration. He was a physician, accustomed to calculate diets. On a four weeks vacation he increased his food intake approximately 50 per cent, mainly in carbohydrates, slept from ten to fourteen hours a day, took no violent exercise, and spent most of his time on a hammock on the porch, engaged in reading current non-medical magazines and novels. His weight remained constant.

Although it is premature to hazard speculation on the subject, the indication is that the emphasis put upon carbohydrate intake as a cause of obesity has been misplaced and that fat in the food is a more important factor in producing overweight than we have hitherto supposed.

### 2. Types of Obesity

Before undertaking treatment, a careful study of the type of obesity present is necessary. Obesity has been divided into exogenous obesity and

endogenous obesity. In the exogenous type the fat is deposited as a result of excessive intake of foodstuffs: in the endogenous type the obesity is due to an internal metabolic disturbance, usually the result of unbalance of the ductless glands. The endogenous type is definitely pathologic, most of the gross and bizarre examples of obesity belonging in this group. It is treated by extracts of the ductless glands combined with the methods of reduction below suggested.

Exogenous obesity does not itself represent a single entity. Some of the patients have a constitutional build and heredity which predispose to obesity in spite of comparatively abstemious methods of living. Their lungs are small, and oxidation is thereby restricted and the tendency to exertion restricted. This is the type of bodily habitus called herbivorous by Goldthwaite. There is another type of fat person with only a moderate tendency towards this heavy habitus who simply eats too much and exercises too little. This type can be treated more satisfactorily than any other form. Personally I divide obesity into three forms: (a) Due to habits; (b) due to habitus; and (c) due to endocrine imbalance.

### Treatment of Obesity

**a. Due to Habits.**—The treatment of obesity of this form is a plain mathematical procedure.

Theoretically overfeeding plus underexercise equals overweight. Therefore underfeeding plus overexercise equals reduction.

But there is an unknown factor, X, in the equation in actual practice: that unknown is human nature. Why the gustatory sensation should be so tragically powerful a thing, outweighing judgment, experience and the fear of death, is one of those mysteries of the human spirit which we can only accept. In a feeble way, it is true, we can explain it. It is the ancient primal instinct of self-preservation, hunger, but perverted, functioning after the necessity for it has disappeared. And like the perversion of that other primal instinct of sex, it results in hideous and disgusting shapes; but whereas the hideousness of sexual perversion exists in the moral world, the perversion of the appetite for sustenance results in grotesqueries in the physical aspect. And why should it be that the momentary pleasure of rolling a bit of creamed lobster on the tongue, surrounding with saliva a dainty dessert, smelling and sipping a plate of mushroom soup—why should these things be more powerful than the highly lauded human reason? The pleasure is momentary and after they are swallowed not only disappears but frequently gives rise to pain.

This philosophical discourse is not idly set down. The patient must

understand the dangers and the pitfalls of excessive intake just as much as the drunkard must.

In my experience institutional treatment is the only method which can be relied on. Less than 6 per cent of cases, treated under physician's instructions in their own home, made any substantial reduction.

The diets used are specified in the chapter on Diet in Part I.

Accessory methods are steam baths, electric light baths, the Bergonie electric treatment, massage and brine baths.

The use of Vichy and Kissingen water in good amounts on alternate days has been recommended.

**b. Due to Habitus.**—The same general plan of treatment is used in the form due to habitus as in the form due to habits. It must be more rigorously used and supervised, however, to be beneficial.

**c. Endogenous Obesity.**—The use of extracts of the ductless glands in combination with diet in proper cases is indicated. Thyroid and pituitary obesity are most frequently seen. See chapter on ductless glands, Part I.

## GOUT

The treatment of gout is largely empirical, based partly on our belief of the rôle of uric acid in the pathogenesis of the condition.

1. *Diet.*—Purin-free foods. See Chapter V on Diet.
2. *Exercise and gymnastics.*
3. *Restriction or deletion of alcohol.*
4. *Drugs:*

*Colchicum* given in the wine, half a teaspoonful (1 c.c.) every two hours for 4 doses and then every four hours until pain is relieved.

*Atophan* (cinchophen) in the dosage of 5-10 grains every three to six hours. These drugs are often specific in their action. If they do not act opium may be necessary.

## TREATMENT OF INFANTILE RICKETS. (RACHITIS)

By Frank C. Neff, M.D.

A wonderful advance has been made in the past few years in the study of the etiology and thereby the treatment of rickets. With the wealth of communications in the recent literature, it is not to be wondered at that there still exists marked difference of opinion as to whether one or more factors must be assigned to its etiology.

### Relation of Climate and Race

Though the present consideration is that of treatment, the occurrence and prevention of rickets is so intimately connected with the methods

of its cure that we must take a somewhat broad view of the subject. If, as formerly thought, rickets is a disease of the cities, then the prevention would obviously lie in country life at least during the susceptible age. But the fact remains that infants do acquire the disease in rural communities as well as in cities, that it is found among the rich as well as the poor, though not in equal numbers for obvious reasons. It has been reported absent in the tropics and in Alaska. It undoubtedly can occur in either. It develops rarely following debilitating diseases, and not constantly on diets that are woefully lacking in nutritional elements and amounts. It may occur in the breast-fed infant, notably the American negro, whose weight and general welfare may be up to the normal. The opinion is fast gaining ground that artificially- and even breast-fed babies in any social state have a greater incidence of rickets than was thought, now that early and latent manifestations of mild character can be proved by x-ray. A change of environment from the sunny climes to that of the temperate zones may increase the susceptibility of the southern races, especially when the new environment is a change from the open air and uncrowded life. This is seen in the dark-skinned peoples of our cities, whose skins have become tolerant of large quantities of light and whose pigment absorbs and prevents moderate amounts from filtering through, to be appropriated by the organism. The negro needs and can tolerate through long exposure the sun's rays to an extent not available to the inhabitant of the colder climates especially in the winter months.

The analogy between the plant cells and the human tissue cells in their common need for an abundant amount of light and sunshine is evident. Whatever the intermediate metabolic and chemical processes through which rickets becomes manifest, it is clearly proved that deprivation of light and sunshine is one causative factor, and the end result is a diminished amount of mineral salts in the skeleton of the body through insufficient deposition or a more than physiologic resorption.

**Poor Hygiene**

Some of the students of this subject are not ready to disregard the influence of the hygienic factor in rickets causation. Domestication, overcrowding, lack of ventilation, lack of exercise (suboxidation), the development of harmful end-products of digestion, the influence of infections, etc., are thought by many to play important rôles. These factors can be conceded, especially if one recognizes that they all mean confinement in an environment away from the preventive and healing rays of the sun.

### Diet

That sufficient mineral salts for the body needs may frequently be missing from the dietary is believable when one has seen infants fed for considerable periods on such weak mixtures as barley water alone, albumen water, condensed milk, dilute milk formulae, etc., but that this practice results regularly in the development of rickets is not proved by experience. Rickets may develop in spite of a food which is high in calcium, nor will an adequate diet alone cure the case already developed. As proved by Howland and others the calcium content of the blood in rickets is little if any reduced. The disease has been regularly produced in certain laboratory animals, especially the rat, when fed upon deficient diets, and is prevented by a standard diet to which is added an inorganic salt. Until the recent use of the x-ray plate for studying the ends of the long bones, more or less doubt has existed as to the correct interpretation of rachitic symptoms, especially in animals. With the human infant it is not unusual to hear conflicting opinions as to the presence of the disease, and it is often, at least by clinical methods, hard to determine incipient or latent rickets.

Rickets does develop in some breast-fed infants, whether due to a dietary cause such as insufficient breast milk, improper diet of the nursing mother, or meddlesome additional feeding of the baby, or lack of sunshine.

The absence of a protective substance, such as the fat-soluble vitamin A or vitamin D, has been urged as the cause. Vitamin A, in butter fat, up to 10 per cent of the diet does not prevent or cure the disease according to Pappenheimer. Mellanby, in England, believed that an antirachitic factor similar or identical with fat-soluble A was necessary to prevent rickets, but he now takes a broader view of the cause, such as the interrelation of the various food elements, deficiency of mineral salts and meats, excess of cereals and carbohydrates, lack of exercise, etc.

The most recent work on the causative factor in rickets shows that the diet is deficient in a fourth vitamin, designated as D. The vitamin itself has not been isolated, but its parent substance or provitamin has been found in cholesterol and ergosterol, which substances can be made antirachitic by exposure to ultraviolet light (Rosenheim and Webster, London, The Lancet, Feb. 5, 1927, p. 306). McCollum has now shown that cod liver oil, through its vitamin D content, when fed to the mother rat, will transmit the antirachitic factor to her milk, and will protect her young even on a rickets-producing diet. (McCollum, Simmonds, Becker and Shipley, Am. Jour. Dis. Children., 1927, xxxiii, 230.)

A diet containing all the needed food elements in proper amount but deficient in phosphorus will produce rickets. Pappenheimer (Jour.

Exper. Med., April, 1922, p. 421) has produced rickets in animals by a diet deficient in phosphates.

The diet should contain meat which gives an abundance of phosphorus, egg, butter, vegetables in the form of soup or purée, from a pint to one quart of milk, orange juice, cereal and sugar. The writer impresses upon the mother the fact that cod-liver oil is to be given through many months as an important food element.

The feeding of calcium salts in large amount was found by Howland and Kramer (Amer. Jour. Dis. Child., August, 1921, xxii, 105) to have no effect upon the amount of calcium in the blood serum.

In rickets there is a low amount of inorganic phosphorus in the blood (3 mg. or less per 100 c.c.). This rises to the normal when the disease is cured. The low phosphorus content may be the cause of deficient calcium deposits in the bones.

Shipley (Jour. Am. Med. Assn., Nov. 4, 1922, p. 1564) studied the bones of animals on faulty diet to find the cause of rickets and was surprised to find that the growth and physiology of bone tissue is not as supposed uniformly the same but is easily influenced by variations in diet. The factors or principles concerned in bone growth are not only calcium, phosphorus, water-soluble B, fat-soluble B, but an organic substance or vitamin distinct from fat-soluble A—probably vitamin D.

### Rickets in Premature Infants

Huenekens drew attention to the frequency of rickets in the premature infant, and more recently Julius Hess has stated that every such infant should be regarded as a potential case of rickets, in whom it develops as early as the second to fourth month, which is earlier by one or two months than the early symptoms develop in the full-term infant as shown by the x-ray.* Because of the low calcium retention, the small amount of salts in the body, the usual underfeeding, the inadequate amount of fresh air and the overheating of premature infants, it is advisable as Hess recommends to increase the amount of fresh air and sunshine, handling, protection against infection, and to begin the use of cod-liver oil and phosphorus by the first month and cereal gruel in the fourth month.

### The Teeth

Attention is now being paid to the effect of dietary deficiencies on the decay of teeth. The well-known calcium need in pregnant mothers

*B. Hamilton (Metabolism of Prematurely Born Infants, Acta Pediatrica, Stockholm, July 31, 1922, ii, 1) showed that full-term infants have at birth a surplus of calcium, which is low in the premature. He believes treatment should be tried to overcome this deficit.

is responsible for dental caries or hypoplasia. McCollum and others (The Relation of Nutrition to Tooth Development and Preservation, Bull. Johns Hopkins Hosp., June, 1922, xxxiii, 216) have produced defects in the mouth by changes in the diet.

The feeding to children of approximately one quart of milk daily and in addition some vegetables causes the optimal storage of calcium with the best development of the teeth and bones.

### Rickets a Seasonal Disease

For some time it has been noted that rickets and infantile tetany develop during the late fall, winter and early spring months. This fact undoubtedly drew the attention of observers to the cause thereof, which was first considered to be the close housing at this time of year, and, as a corollary, the lack of fresh air, sunshine and shorter days with less duration and intensity of the sun's rays. With the observation that infants did not develop rickets when exposed to sufficient sunshine, and that cases were speedily cured by the same method came the evidence that sunshine is both a prevention and cure.

Radiographic pictures of the bones in such cases show that more calcium is being retained, there is a more regular growth of the cartilage, the extremities and shafts of the bone recover their right proportions, and the osteoid tissue at the metaphysis and under the periosteum is lessened.

According to Alfred Hess there is a low inorganic phosphate content of the blood in the winter months, but when there is an abundance of light as in summer the serum contains a normal amount (four to five mg. per 100 c.c. of blood).

### Preventive Treatment—Hygiene

Two superstitions that have somehow become broadcasted among the laity and to a greater extent even more among nurses and physicians, are that (1) infants should not be handled or (2) taken out of doors frequently in the cooler months of the year. As a protest against the meddlesome interference with the quiet and sleep of the breast-fed baby the conviction has been formed by certain well-meaning but extreme individuals that this germ of truth should apply constantly to all infants. Certainly the bottle-fed infant whether in the home or in the institution should be handled and "mothered." As a routine infants should daily be taken out of doors into the sunshine. It is the overdressed child, living in the overheated and poorly ventilated rooms who becomes "soft" and the victim of constant "colds" which are attributed to exposure by the fresh air which trickles in from a window, to cool apartments, or to a few minutes in the open air.

### Treatment with Cod-Liver Oil and Egg Yolk

It is interesting to note that the empirical and clinical administration of cod-liver oil has been justified recently by the x-ray findings as a definite prevention and cure of rickets. Hess, of New York, in his work among the negro population prevented rickets by widespread feeding of this oil. All pediatricians are using it as a routine in the artificially fed, especially among dispensary and negro cases. The synthetic milk, S.M.A., devised by Gerstenberger of Cleveland contains a definite proportion of cod-liver oil which is of marked value as a prophylactic in the infants receiving it.

This oil holds first place in the prevention and therapy, and is used as a control in comparing the results obtained by other methods.

I have found that its exhibition throughout the winter will cure the disease so that after 3 months of active treatment, no further evidences of active manifestation may be expected. It is advisable to give it again the second winter as a protection against a relapse or second manifestation.

Probably the best method of administering cod-liver oil to infants is with the feedings. The pure oil is used, and there are numerous potent preparations of it now on the market. It is better to purchase oil which has been sealed in small containers, kept away from the light, and tightly stoppered. As a preventive, 15 drops (1 c.c.) is given by the mouth with each nursing or in each nursing bottle. Therapeutically, the curative dose is much larger, from one to two teaspoonfuls are to be administered, three times daily for several months.

Egg yolk has been recently fed as a prophylactic and curative food in rickets because of its fat soluble vitamin content. (Still, G. F.: Textbook, 1915, p. 104. Mellunby, E.: Experimental Rickets, Med. Res. Council, London, 1921, p. 65. De Sanctis, A. G.: Arch. Pediat., Feb., 1922. Casparis, H., Shipley, P. G., and Kramer, B.: Jour. Am. Med. Assn., Sept. 8, 1923.)

Improvement in rickets begins in a few weeks from the inception of the feeding of one or two yolks daily. For the prevention of rickets, one yolk daily is sufficient. The value, therefore, of egg yolk will be found as a substitute for the more potent cod-liver oil when oil is not well borne by the infant's stomach.

### Treatment by Sunshine

Naturally this offers a satisfactory practical and economical method of treating rickets, the only obstacle being the cloudiness and inclemency of portions of the winter months.

Treatment should be in the open air exposed to direct sunlight. As

much of the baby's body as is consistent with the weather should be exposed. The face can be left uncovered in any weather, while the forearms and hands may be exposed for periods in reasonable temperature. Out-door light and wind will burn the skin of many infants in a few hours, so one finds it better to begin with the exposure of 30 minutes or less the first day and a daily lengthening of the time as fast as the infant can tolerate it. There are mild days in which the legs and upper parts of the chest can be exposed, especially if attention is paid to keeping the child as a whole comfortably warm. However

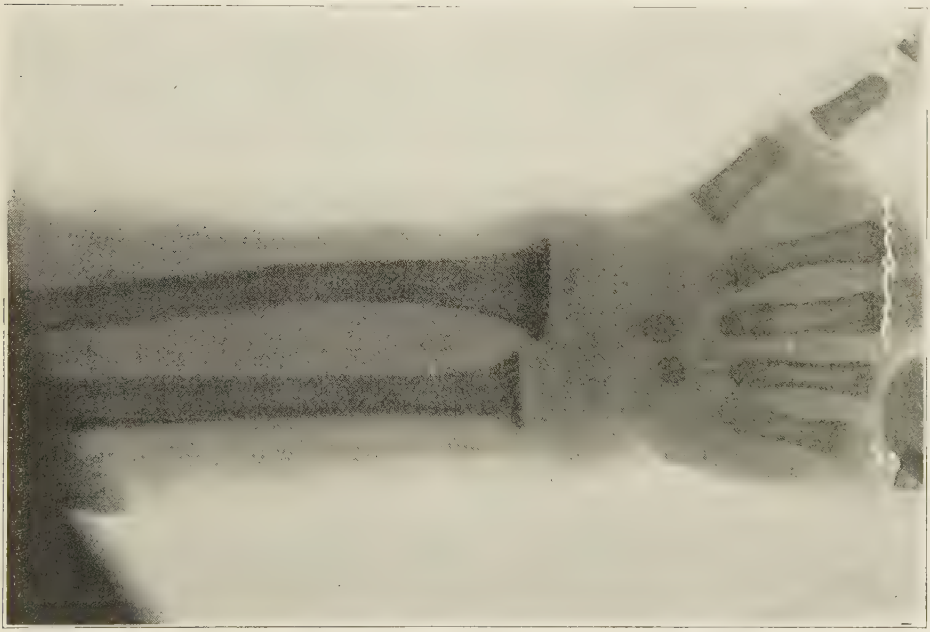


Fig. 77.—Twelve-months-old girl showing marked improvement in the width of the shafts of the radius and ulna, and increased calcification at the epiphyses following a month's treatment by tri-weekly exposures to the ultraviolet ray. The exposures at the first sittings were only a few minutes, but as the child became accustomed to the rays, the length of exposure was increased to the point of tolerance. While the above picture shows still the evidences of rickets in the width of the ends and the narrow shaft and curving, the marked benefit is seen over radiogram taken one month previously. Clinically the child had not made any attempt at walking and was far behind in normal activity for its age. At the time this picture was taken the mother had noticed definite improvement in all lines. This treatment was given in the winter months during a particularly dark and cloudy season of inclement weather, when it was impossible to secure sufficient sunshine for curative purposes.

it has been found that general improvement will take place even if only one portion of the body such as the arm, is exposed.

### The Use of the Mercury Quartz Lamp (Ultraviolet Light)

Radiation by the short ultraviolet rays from the quartz lamp has been proved by various workers to have a curative effect similar to

sunshine and cod-liver oil and to promote the growth and calcification of bones. (Powers, Park *et al:* Johns Hopkins Hosp. Bull., April, 1922, xxxiii, No. 374.) This method is now in practical use in all cities and the constant improvement is clearly proved by radiograms.

Hess (Jour. Am. Med. Assn., May 27, 1922, lxxviii, p. 1596) has recommended the simple use of artificial irradiation by using the carbon arc lamp which causes no burns or pigmentation of the skin. The infant is placed at a distance of three to nine feet from the light, the eyes protected. The white flame 110 volts, adjusted to 15 amperes, is employed.

From a practical standpoint these methods need only be used in winter months when sunshine is difficult to obtain or when artificial irradiation is easily available. The employment of cod-liver oil is so simple that it can be the sole method, though the hygienic effect of fresh air and its attendant sunlight should never be neglected.

The quartz mercury lamp is used without filter, the dosage is not pushed until the child is accustomed to the rays. A cure is effected in two months, using a treatment every two or three days. (Huldschinsky: Ztschr. f. Orthop. Chir., 1920, xxxix.)

A great many physicians now have ultraviolet rays lamps, dispensaries are so equipped, and in some communities an outfit may be rented by the family under the physician's direction. The physician must learn the proper distance of the lamp and the length of exposure, so that burns will not result. Treatments on every other day are more practical for rickets, and such will assist in the increase of phosphorus in the blood and the retention of calcium in the bones, the latter clearly shown by roentgen pictures of the wrists at monthly intervals.

### Treatment of Convulsive and Nervous Cases

That the rickety child is the subject of nervous and often convulsive seizures is well known and calls for constant supervision. Such a child should be allowed plenty of sleep, and should be guarded against infections which are frequently initiated with convulsions. With the general treatment for the cure of rickets an improvement will take place, but during the period of convalescence frequent bathing and the daily addition of a sedative such as calcium bromide from one to three grains to each dose of the phosphorized cod-liver oil will be found beneficial.

### Treatment of Fractures and Deformities

During the florid stage, fractures of the clavicle are common. The marked bowing of the softened long bones at this stage may be aggra-

vated by attempts to walk, but the infant intuitively guards against this by refusing to try. The child should be protected from trauma in every way.

An early diagnosis and a rapid cure of the disease will minimize the deformities, which if persistent after the disease is cured should have orthopedic treatment. Asymmetries of the chest which interfere with proper lung capacity should be treated by breathing and gymnastic exercises. Measures to develop or maintain the proper posture and the muscle tone of the abdomen and extremities, and the wearing of corrective shoes for weak or pronated feet should be followed.

## TREATMENT OF INFANTILE SCURVY (SCORBUTUS)

By Frank C. Neff, M.D.

Both the profession and the laity have become much better informed during the last few years concerning the necessity for an antiscorbutic element in the dietary of the child. This applies during the first three years of life, but especially to the infant while exclusively artificially fed. It is now the practice of most physicians to increase the diet beyond the ordinary bottle formula even as early as the second or third month, for latent scurvy may exist at this time though it is seldom frankly manifested before the age of six months. As a result of the general publicity given the vitamin theory especially the rôle played by vitamin C as the necessary protective factor, and because of better feeding methods, scurvy will be more and more rare in this country. In private practice especially well-developed scurvy is a rarity. It has been one's experience until recently that the diagnosis is apt to be overlooked.

### Prescurvy

The disease is present in a latent state more commonly than suspected. This is found in the fact that it has a rather long period of development, and the profession as a whole has not been familiar with the early and less known symptoms. An infant because of nutritional disturbance may receive a much needed increase in the diet which clears up a state of ill health not recognized specificially as early scurvy. Holt (Holt, L. Emmett: Vitamin Studies, Jour. Am. Med. Assn., July 8, 1922, p. 129) has stated that impending scurvy can be detected by the appearance of punctate skin hemorrhages and hematuria as long as two months before the disease has become well developed.

DeCastro's (Estella B. de Castro: Arch. Espanoles de Pediat., Madrid, 1922, vi, 641) experience in Spain has been that "prescurvy" in 50 per

cent of the cases does not pass beyond the early phases, during which there will be some edema, weakness, tenderness, disability and blood vessel disturbance.

When one considers how many neglected infants there have been who were not receiving a complete diet, he wonders at the rarity of scurvy, and he cannot but feel that prescurvy must have been present in many instances.

### Sequelae of Scurvy

It seems to me that too little attention has been paid to sequelae of scurvy. It seems too much to expect that such a severe nutritional disturbance lasting as long as it does is apparently cured in a few days by the administration of orange juice, and that there will be no stunting of growth or production of deformities. Beading of the ribs (described by Alfred Hess as a symptom of scrvy as well as of rickets) and subperiosteal hemorrhages of the long and rapidly growing bones of the infant are pathologic conditions which take time to restore to normal size and contour. The retarding effect of one or more attacks of scurvy upon the growth and development of the child has now been definitely proved (Chick and Dalyell: Brit. Med. Jour., 1921, ii, No. 3182, p. 1067). Children with such a history were found to be substandard markedly, and after treatment with antiscorbutic and fat diets showed a remarkable amount of recovery from their retardation and deformity.

### Dietary and Other Causative Factors

From what has been said concerning the potentiality of scurvy, it is evident that protection should be given all infants by a supervision of the diet and by the maintenance of normal nutrition and health.

Before proceeding to the question of what constitutes a protective diet, it is well to consider why infants on a similar deficient diet, do not all develop scurvy. Scurvy is produced experimentally in all laboratory animals on an inadequate dietary. This is not true in the young of the human species, unless latency and the frequent changes in the infant's food make the disease unrecognized. Fortunately it is the exception to find a family the members of whom do not give the baby a taste of this or that food from the table, which practice gives a needed variety from the monotonous and incomplete bottle food.

One of the common but frequently overlooked symptoms of the disease is a diminished urine output (oliguria), quickly increased by the ingestion of orange juice. Gerstenberger (Gerstenberger: Hypothesis of Pathogenesis of Infantile Scurvy, Am. Jour. Med. Sc., February, 1918,

clv, 253) believes that there is a protective salt retention or hindered secretion as the cause of lessened water output. This theory is in accordance with the symptoms of edema found in the disease. A frank or an invisible edema is a part of the clinical picture, (Nobel: Zeitschr. f. Kinderh., Berlin, April 4, 1921, p. 348) and the variation in the amount of edema explains the sudden increase or decrease in body weight.

The elaboration of intestinal toxins due to an overgrowth of harmful bacterial flora not controlled by a proper diet is offered as an explanation of the cause (Alfred Hess). The faulty diet produces a marked effect upon the mineral metabolism of the body.

A somewhat similar theory is that the retention of the feces, decreased peristalsis, reduced intestinal secretions, production of intestinal lesions, increased permeability of the vessel walls, with absorption of toxic products are caused by the physical characteristics of the diet and the type of intestinal flora, and that from all these factors scurvy develops (Pitz: Jour. Biol. Chem., November, 1918, p. 439).

Intestinal stasis or constipation has been thought by some (McCollum and others) as causative of human scurvy, and that laxatives will cure it. This is not the experience of pediatricians and is doubted by most writers.

The absence of vitamin C interferes with the nutrition of the capillary endothelium causing degeneration and later permits the passage of blood into the surrounding tissues and also the development of severe general nutritional disorders. (Bierich: Deutch. Arch. f. klin. Med., 1919, cxxx, 151. Finlay, G. M.: Jour. Path. and Bacteriol., 1921. xxiv, 446.)

The presence of infection has been found by some observers to cause scurvy in groups of children. In laboratory animals with scurvy there is found a reduced resistance to definite inoculations with microorganisms such as bacilli coli.

Reduction in the vitamin content of the milk, has been studied as an explanation of the occurrence of the disease. Cows fed on green food will have a higher antiscorbutic element in the milk. Many factors in the handling of milk, whether heating, aging, drying, may reduce the antiscorbutic property to a degree that is incompatible with the welfare of the infant. The diet and health of the mother may be responsible for the disease in the breast-fed child, though its appearance in such infants has been reported but rarely.

It is unnecessary here to discuss the many differences of opinion as to the influence of the numerous described factors in the milk formula, since these opinions vary so greatly, and since the addition of known antiscorbutics will easily prevent and cure scurvy.

### Prevention of Scurvy

1. Most important is the maintenance of all or a part of the breast nursing at each feeding. Insufficient secretion from the breast is no cause for weaning. When additions are needed, the bottle, spoon or cup may be used to supply the amount of food required. Whole milk, diluted milk, skimmed milk, a fruit juice, cereal, vegetable juice or purée, are to be fed in proper amounts to suit the individual case. When lactation ceases, it is not difficult to continue the artificial feeding in increased amount.

2. A practical method used in artificial feeding by the writer is to begin as early as three months of age a weak vegetable soup as the diluent for the milk, and also before one of the feedings a tablespoonful (15 c.c.) of sweetened orange juice. Water in which spinach or other vegetable has been boiled, if desired the addition of the determined amount of cereal (such as barley), certified or other clean fresh milk (boiled or raw as required) and sugar of desired kind and amount, will furnish a diet completely adequate to prevent scurvy. At six months of age the vegetable may be given separately or in a soup, in amounts tolerated by the individual child.

The antiscorbutic vegetables used in making soup, such as spinach, cabbage, tomato, cauliflower, potato, germinated beans, should be chopped, kept moist and added to the soup just before it is done, giving just enough cooking to render them soft and palatable. (Chick and Dalyell: Zeitsch. f. Kinderh., Berlin, Oct. 8, 1920, p. 257.) Vegetables and fruits cooked by steaming retain their properties better than by other methods. Overcooking vegetables was assigned as the cause of an outbreak of scurvy in a Berlin institution for children. Probably no method of rapid and satisfactory cooking is equal to that of steam under high pressure, as short a time as ten minutes being required. The cost of the cooker utensil is at present the only drawback.

The amount of orange juice necessary to prevent scurvy in the guinea pig has been found definitely to be 3 c.c. These animals weigh from 150 to 500 grams (4 to 18 oz.). In estimating the amount needed to protect the human infant on this basis of weight, a seven-pound baby would require roughly one-half ounce (15 c.c.) daily, and a baby of twice the weight one ounce (30 c.c.) daily. (Hess, Julius H., Moore, J. J., Colvin, J. K.: Trans. Amer. Pediat. Soc., 1922.)

### The Cure of Scurvy

Orange juice has long held first place in the therapy which is specifically dietary. A larger amount than is fed as a prophylactic is desirable.

An ounce or more daily, depending on the age, weight and tolerance of the child, and the severity of the disease, is advisable. An antiscorbutic should be continued permanently in the diet to prevent recurrences and to aid in the establishment and maintenance of normal nutrition. Nothing is more striking than the therapeutic results in the rapid disappearance of hemorrhages from the gums and the disability of the scorbutic child.

Occasionally orange juice causes symptoms of indigestion, or it is not always available in remote communities, or at certain seasons. Bottled orange juice, dried preparations, infusion of orange peel are of use, and some one of these can be obtained in any community.

It is well to bear in mind the usefulness of canned or fresh tomato juice which is well tolerated and probably of equal value to orange juice. The juices and soups obtained from vegetables above mentioned are of assistance.

Raw beef juice does not prevent scurvy in the guinea pig. (Dutcher, Pierson and Biester: Jour. Biol. Chem., Baltimore, 1920, xlii, 301.)

When the diet needs general enlargement because of its inadequacy and the extreme low state of the nutrition, the food requirements of the individual must be met. In extreme cases in younger infants, wet-nursing for a few weeks has been found of value.

Cod-liver oil and iron, and the necessary hygienic measures should be employed.

## References

### *Diabetes*

(NOTE: The outline of the pathologic physiology of diabetes in this book merely sketches the main headings of the subject. A more complete introduction to the very voluminous literature will be found in the following books and articles. No student of diabetes can afford to go on without reading all of them.)

Addis: Operations on Diabetics, Jour. Am. Med. Assn., April 3, 1915, lxiv, No. 14.

Allen, F. M.: Total Dietary Restriction in the Treatment of Diabetes, Monograph II Rockefeller Institute for Med. Research, 1919.

Allen: The Treatment of Combined Diabetes and Nephritis, Jour. Am. Med. Assn., August 14, 1920, lxxv, No. 7.

Barron: The Relation of the Islets of Langerhans to Diabetes, etc., Surg., Gynec. and Obst., November, 1920, xxi, No. 5. (Good photomicrographs).

Bensley: The Islets of Langerhans, Harvey Lectures, 1914-1915.

Hamman: Introductory Remarks to a Discussion of Diabetes, Med. Clinics North America, ii, No. 6. (A good short review).

Henderson: Am. Jour. Phys., 1908, xxi, 427.

Jonas and Musser: An Outline of a Routine for Insulin Therapy, Am. Jour. Med Sci., April, 1924, clxviii, No. 4.

Joslin: The Treatment of Diabetes Mellitus, Lea & Febiger. (A great storehouse of classified information.)

Lawrence, R. D.: The Diabetic Life, J. and A. Churchill, London, 1925.

McHenry and Cooper: Diabetic Diets. A Handbook for Diebetics. Harper and Brothers, New York, 1925.

Mueller, Wiener and Wiener: The Mechanism of Insulin Action, Arch. Int. Med., April, 1926, xxxvii, No. 4.

Muller, F.: Verhandl. d. Cong. f. inn. Med., 1906, xxiii, 100.

Newburgh and Marsh: The Use of a High Fat Diet in the Treatment of Diabetes Mellitus, Arch. Int. Med., December, 1920, xxvi, 647.

O'Hara: A Chart for the Rapid Estimation of Woodyatt's Optimal Diabetic Diet, Jour. Am. Med. Assn., April 15, 1922, lxxviii, No. 15.

Sansum, Blatherwick and Bowden: The Use of High Carbohydrate Diets in the Treatment of Diabetes Mellitus. Jour. Am. Med. Assn., January 16, 1926, lxxxvi, No. 3.

Shaffer: Antiketogenesis; the Ketogenic, Antiketogenic Balance in Man and Its Significance in Diabetes, Jour. Biol. Chem., February, 1922, l, 26.

Strouse: Balancing the Diabetic Diet, Jour. Am. Med. Assn., December 2, 1922, lxxix, No. 23.

von Noorden: Diabetes Mellitus, Its Pathological Chemistry and Treatment, New York, E. B. Treat & Co., 1905. (Somewhat out of date but the best short introduction to the subject.)

von Noorden: The Theory and Treatment of Diabetes, Am. Jour. Med. Sc., 1913, cxlv, No. 1.

Wilder: Optimal Food Mixtures for Diabetic Patients, Jour. Am. Med. Assn., June 17, 1922, lxxviii, No. 24.

Woodyatt: Objects and Methods of Diet Adjustments in Diabetes, Arch. Int. Med., August, 1921, xxviii, No. 2.

### *Insulin*

Allen: Summary of Publications on Insulin, Jour. Metabolic Research, August, 1922.

Allen: Treatment of Diabetes with Insulin, Jour. Am. Med. Assn., Oct. 20, 1923, lxxxi, No. 16.

Banting and Best: The Internal Secretion of the Pancreas, Jour. Lab. and Clin. Med., Feb., 1922.

Banting, Best, Collip, Campbell and Fletcher: Pancreatic Extracts in the Treatment of Diabetes Mellitus, Can. Med. Assn. Jour., March, 1922.

Insulin Committee of the University of Toronto—Insulin: Its Action, Its Therapeutic Value in Diabetes and Its Manufacture. Jr. Am. Med. Assn., June, 1923.

### *Obesity*

Means: The Metabolism in Obesity, Arch. Int. Med., 1916, xvii, 704.

Strouse and Dye: Studies on the Metabolism of Obesity, Arch. Int. Med., September, 1924, xxxiv, No. 3.

### *Scurvy*

See references in text.

### *Rickets*

See references in text.

## CHAPTER XVII

## DISEASES OF THE BLOOD

### I. INTRODUCTION

The blood is a tissue which consists of three elements—red cells, white cells and platelets—suspended in the serum. These elements each have a normal life cycle—a place of origin, a term in circulation and a place and time of destruction. The diseases to which the blood is subject may be due to destructive or toxic agents exerted upon the place of origin (a defect in production of the red cells, white cells, or platelets) or to a stimulus to production (an increase in production of red cells, white cells or platelets); or to mechanical loss (hemorrhage) or destruction (toxic action) while in circulation; or to increase, (premature activity), or decrease in the destructive centers. These theoretical possibilities present themselves, although we are not in a position to classify the actual blood diseases accurately in these divisions. We know a good deal about the origin but almost nothing of the fate of the blood cells. Allowing for that, however, we may venture to classify blood diseases as follows:

I. *Due to abnormalities of the process of origin:*
   1. Red cells.
      a. Aplastic anemia.
      b. Pernicious anemia (?) (May be due to increased destruction.)
      c. Erythrocythemia (?) (May be due to defective destruction.)
   2. White cells.
      a. Splenomedullary leucemia (?)
      b. Lymphatic leucemia (?)
   3. Platelets.
      a. Purpura hemorrhagica.
      b. Hemorrhagic disease of the newborn.
      c. Hemophilia (?)

II. *Due to mechanical or destructive blood loss:*
   1. Red cells.
      a. Secondary anemia.
      b. Chlorosis.

2. White cells.
   None.
3. Platelets.
   None.

III. *Due to abnormalities of the method of destruction:*

1. Red cells.
   a. Hemolytic jaundice.
   b. Splenic anemia (Banti's disease).
2. White cells.
   Gaucher's disease (?)
3. Platelets.
   Hemorrhagic diseases (?)

IV. *Mixed or doubtful processes:*

Von Jaksch's anemia—pseudoleucemia.

### Life Cycle of Blood Cells

Red cells come exclusively from the red bone marrow. In childhood the long bones as well as the flat bones contain red marrow: in adult life the short and flat bones alone, under normal conditions, contain active marrow. However, under the stimulus of unusual conditions long bone marrow may begin to functionate. In the marrow the red cells develop, from special marrow cells which, unlike the red cells, each contain a nucleus—the erythroblasts. The erythroblasts multiply by mitotic division and develop into more basophilic, higher hemoglobin-containing cells called normoblasts, which, on losing the nuclei, become circulating red cells. What the term of life of a red cell in circulation is we do not know definitely. Ashley contends that transfused corpuscles remain in the recipient's blood stream for forty days. The term of the red cells entering the circulation normally must be much longer. The destruction of red cells probably occurs in the spleen. This is by no means definitely proved: the spleen can be removed without apparently affecting the life cycle of the blood cells in any way, but it is not improbable that other tissues, i.e., hemal lymph nodes, may act as accessory spleens, and take up the hemolytic functions of the spleen when the spleen is removed. The spleen and the liver are closely bound together. One imaginative physiologist has suggested that they are as closely connected, functionally, as the glomeruli and tubules of the kidney: that it is only an accident of morphology that they are separated by the width of the abdomen. Their blood supply is intimate and certain it is that some of the excretory products of the liver are derived from hemoglobin.

Of the white cells, the granular leucocytes originate probably exclusively in the red bone marrow. The mother cell is the myeloblast. These are large, basophilic staining cells, with large nuclei. They give rise to other cells—myelocytes—with less basophilic, more granular cytoplasm. There was at one time, an attempt to show that the lymphocytes were split-offs at an early undifferentiated stage from the myeloblast but this idea has largely been abandoned. The lymphocytes originate in lymphatic tissue wherever found. The large lymphocytes are probably simply younger forms than the small lymphocytes. The length of life and place of destruction of white cells is not known: most of them are probably destroyed on the outworks of the body's defensive system: they appear in nasal, vaginal and oral secretions, in feces and urine, etc.

The platelets are not independent cells, but are probably detached portions of the cytoplasm of a special kind of marrow cell—the megakaryocyte. These megakaryocytes are the largest cells in the marrow. They have very large lobulated nuclei, and a cytoplasm filled with granules which stain exactly in the same way as the platelets. The platelets probably separate off or are extruded at the periphery of the megakaryocyte.

In general, in the treatment of blood diseases, we may employ measures (1) to supplant the function of the marrow, or stimulate it, if it is diseased, intoxicated or overworked; (2) to inhibit it or the lymphatics if they appear to be over-productive or, (3) to remove or destroy the destructive mechanism if the organs of destruction are hypertrophied or over-functioning.

The best method to supplant the function of the marrow is *transfusion.* The methods to stimulate the marrow are the use of *iron, diet* and *rest.* To inhibit marrow activity we have *benzol* and the *x-ray.* To inhibit lymphatic activity is the *x-ray.* To remove the destructive factors we have *splenectomy, x-ray* and *radium.*

## THE ANEMIAS

### 1. Secondary Anemia

**Due to Mechanical Blood Loss.**—The body can withstand the loss of two-thirds of the blood volume, provided a period of twenty-four or forty-eight hours elapses in the process. A destruction of one-third the total amount suddenly, usually results in death. Restoration of such severe losses takes place slowly—three to six months is required to restore the blood picture to normal. Nothing influences the process except transfusion and that probably does not greatly influence the process, but it does provide symptomatic relief and give general support.

### 2. Toxic Anemia (or Infectious Anemia)

Toxic anemia must be treated by attacking the cause.

### 3. Chlorosis

Chlorosis occurs almost entirely in young women at the age of puberty. It is practically always self-limited, spontaneous cure occurring in most cases. The spontaneous cure can be hastened by correcting hygienic faults in living—especially in diet—by the use of iron in large amounts, and by attention to the gastric disturbances and constipation. The iron should be given in amounts up to 30 grains of Blaud's mass or pills. Hypodermic injections of iron (the citrate or cacodylate, 1½ grains every other day) may be used if results are not rapid enough under the oral administration.

### 4. Pernicious Anemia

Pernicious anemia is a chronic disease of the blood-forming, gastrointestinal, and nervous systems. The prominent signs are reduction in the red blood cells to very low levels (2,000,000 per c.mm., or 1,000,000 per c.mm. or even less) with a loss, but not a concomitant loss of hemoglobin, achylia gastrica, and degeneration of the posterior and lateral spinal cord tracts. It usually affects persons about the age of fifty. The onset of anemia is accompanied by a peculiar lemon-yellow tint to the skin. Loss of weight seldom occurs.

The disease is marked by recurrent periods of apparent health. These periods are called remissions, during which the blood regenerates and nearly returns to a normal state. The remissions are followed by relapses, a recurrence of the anemic state. This fact of the appearance of remissions has led rash therapists unacquainted with the natural course of the disease to report cures. The disease is almost invariably fatal.

Cures of pernicious anemia have, in a certain sense, occurred. Remission periods of from seventeen to twenty-four years, which have been reported, can be interpreted only in the sense that some process took place in the body which prevented the recurrence of blood destruction and the fatal outcome.

The feeding of liver and other foods rich in protein similar to liver will in nearly all cases of pernicious anemia cause a prompt remission with regeneration of the blood and, while the ingestion of liver is continued, keep the patient in apparent good health. This fact, recently established, is a contribution of therapeutics to the knowledge of the disease. As yet, so far as one can determine, it is entirely unexplained. But that does not prevent it from being true, nor from being a part of the pathologic physiology of the disease.

**Specific Treatment.**—The treatment of pernicious anemia today rests almost solely upon the use of this liver diet or of the liver extract of Cohn-Minot. Before its introduction the treatment of pernicious anemia was an inglorious fumbling with ineffective methods. The exhibition of liver acts in pernicious anemia almost like a specific serum. All other therapeutic measures are unimportant adjuncts.

1. *Details of Treatment.*—In 1926 Minot and Murphy reported on a series of forty-five patients with pernicious anemia who had been treated by being placed on a diet rich in proteins, especially visceral substances such as liver, kidney, and bone marrow. The patients who were in relapse all showed a prompt remission. Reporting again in 1927 the investigators state that some of the patients have remained on this diet for two and some three years without relapse. These constitute the longest experience with the diet known. Every clinician to whom I have talked or with whom I have corresponded has had a similar good experience with the Minot-Murphy diet.

The diet as recommended consists of a daily ration of:

1. From 120 to 240 gm., and sometimes even more, of cooked calf or beef liver. An equal quantity of lamb's kidneys was substituted occasionally.

2. One hundred and twenty grams of beef or mutton muscle meat.

3. Not less than 300 gm. of vegetables, especially lettuce and spinach, containing from 1 to 10 per cent of carbohydrate.

4. From 250 to 500 gm. of fruit.

5. About 40 gm. of fat derived from butter and cream, allowed in order to make the food attractive. Animal fats and oils were excluded so far as possible.

6. If desired, an egg and 240 gm. of milk.

7. In addition dry and crusty bread, potato and cereals, in order to allow a total intake of between 2,000 and 3,000 calories, usually composed of about 340 gm. of carbohydrate, 135 gm. of protein and not more than 70 gm. of fat. Grossly sweet foods were not allowed, but sugar was permitted very sparingly.

The essential feature of this diet seems unquestionably to be the liver. The active principle in the liver has not been identified nor isolated. Cohn and associates at Harvard have reported a nonprotein, nonfat containing fraction of liver which they believe acts as well as the whole liver. This substance is now on the market as liver extract. It appears to work equally well as the liver itself. The amount of raw liver needed daily is 250 grams.

The conduct of the reticulocytes in the blood has been taken as a standard of measurement of improvement under liver therapy. There occurs a prompt temporary pronounced increase of the reticulocytes in the peripheral blood.

## Liver Menus

Inasmuch as the use of liver extract may be too expensive or a patient may be in so remote a place that it is difficult for him to procure the extract, raw liver itself must frequently be used. As it is not palatable to all people the following methods of preparation have been suggetsed:

Liver Cocktail (recommended by Wilkins).—

Liver: Locate a market where fresh choice calf's liver may be obtained. Place a standing order for a delivery every other day. As soon as each order is received at the kitchen trim off the "skin" around the edges and carefully remove all the veins and tough parts with a sharp knife. Rinse in cold water. Put the prepared liver through a meat grinder twice, using the finest cutter. Place it on ice immediately. One-half pound of liver makes four tablespoonfuls of crushed product.

Sauce: Prepare a sauce as follows:

| | |
|---|---|
| Tomato catchup (Heinz) | ½ cup |
| Lemon juice | ¼ " |
| Worcestershire sauce | 2 teaspoonfuls |
| Chives (finely chopped) | ½ " |
| Salt and pepper | to taste. |

Cocktail: Mix the liver and the sauce in the proportion of one part crushed liver to two and a half parts of sauce. Chill thoroughly and serve in a cocktail glass with salt crackers or wafers.

*Administration:* As for olives and oysters, so also with liver; a person will acquire the taste. In a few days the amount offered, which at first should be very small, may be increased until the patient readily accepts two cocktails daily, each of from two to four tablespoonfuls of crushed liver. It is essential that the following recommendations be strictly adhered to: every tough part must be carefully removed and the liver finely ground; the cocktail must be served and eaten cold with crackers.

With Orange Juice.—Raw liver chopped up in a meat chopper and iced very cold with orange juice has been used successfully.

### Liver Salad

Cubed liver (cooked), 1 cup; cabbage, shredded, ½ cup; green pepper, chopped, 1 tablespoon; carrots, raw, ground, ½ cup; onion, chopped, 1 tablespoon; mayonnaise. Marinate cubed liver for one hour. (A good marinade is made by mixing 3 parts vinegar with 1 part mazola, adding salt to taste). Drain, add vegetables to liver and add enough mayonnaise to moisten. Serve on crisp lettuce, garnish with mayonnaise and parsley.

### Breaded Liver

1 slice liver, 4 x 6 x ½ inches; 1 egg; 2 tablespoons lemon juice; ¼ teaspoon salt; pepper, if desired; ½ cup bread crumbs; ½ tablespoon fat. Pour boiling water over liver. Let stand 7 minutes; drain; remove the membrane. In the meantime have the egg slightly beaten, add lemon juice, salt and pepper. Dip slice of liver in egg. If care is taken practically all of the egg will be used up. Place in a pan containing the melted fat. Set in a hot oven (375° F.) for 25 minutes.

### Carrot Perfection Salad

1 box lemon Jello; 2 tablespoons vinegar; 1⅞ cup boiling water. Dissolve the Jello in the boiling water, add the vinegar, and just as it begins to harden, add 1 cup ground raw carrots, ¼ cup shredded cabbage. Pour into wetted mould to set and serve on lettuce leaf with mayonnaise.

### Liver—Panbroiled with Parsley Butter and Lemon

1 pound liver, slice ½ inch thick; 2 tablespoons fat; salt, pepper, flour. Melt fat in frying pan. Prepare liver as above. Salt, roll in flour; place in pan containing the melted fat and panbroil slowly or the edges will curl and be leathery. Allow 10 minutes for rare, 15 minutes for well done. Flour may be omitted if desired. For parsely butter, cream 2 tablespoons butter, 1 teaspoon lemon juice and 1 tablespoon minced parsley. Serve on panbroiled liver, also add slices of lemon.

### Creamed Liver

1 cup whole milk; 2 tablespoons fat; 2 tablespoons flour; 1½ cup liver, cubed; salt and pepper. Melt the fat in a sauce pan, add flour, stir until smooth, add milk, and stir until it thickens. Add cubed liver, salt and pepper. Cook the liver about 12 minutes (if calf liver; beef liver will require longer and probably more liquid). The liver discolors the liquid, but the result is more savory.

### Liver Broiled with Bacon

1 slice liver, ½ inch thick; 1 slice bacon; salt, pepper, flour. Prepare liver for cooking in the usual way. Salt, roll in flour, place on broiler with the slice of bacon on top. Turn in about 2 minutes, keeping the bacon on top. After it has been turned and the bacon is crisp, remove the bacon, keep hot while the liver finishes cooking. Ten to twelve minutes is long enough.

### Mock Terrapin

1 cup brown sauce (2 tablespoons fat, 2 tablespoons flour, 1 cup brown stock or hot water); 1½ cup liver; ½ cup chopped mushrooms (canned; ⅛ teaspoon paprika; ½ teaspoon salt; 2 tablespoons lemon juice. Make brown sauce, add remaining ingredients, cook 10 minutes. Serve in ramekin with sliced, hard-boiled egg over the top.

(All receipts recommended by Miss Purdy.)

2. *Results of Specific Treatment.*—The way in which liver acts in pernicious anemia is entirely unknown. It is "the antipernicious anemia substance" and that is all that can be said.

The results of treatment are quite uniform. Minot and Murphy furnished data on 105 cases: in every instance a favorable turn occurred in

the disease when liver was fed. Some were in the first, some in the second, and some in the third relapse of their disease. The promptest results were obtained during the first relapses. Cord changes were not notably affected. In a typical case the blood count may be observed to begin to increase at about the fourth day of liver feeding. The reticulocyte peak occurs at the fourth to tenth day. Ordway and Gorham report that in 25 cases the average blood count rose from 1,608,000 to 4,330,000 in three weeks.

Many patients have remained well for four or five years under continuous liver administration. Failures are few but they do occur. Dr. A. D. Dunn reported to me two cases which progressed to death while actually taking liver; one had advanced combined sclerosis.

**Accessory Methods of Treatment.**—1. *Transfusion.*—This probably will be given up since the introduction of the liver diet. There was a very widespread disagreement as to its usefulness. It undoubtedly initiated remission in the first relapse and may perhaps still be used in states of very grave relapse with the patient in coma.

2. *Removal of Focal Infection.*—This theory of causation (focal infection especially in the teeth) enthusiastically recommended by William Hunter, has not proved to have any basis in fact.

3. *Use of Hydrochloric Acid.*—As there is practically always an achylia gastrica present, and a resulting diarrhea, the rationale of the exhibition of hydrochloric acid is obvious. I quote here the method of administration urged by an enthusiastic advocate of its use (I need not entirely agree with his conclusions, but I believe that in therapeutics *a* method of doing a thing is better than "any old" method).

"If an honest effort is to be made to replace the absent HCl and pepsin we should at least approximate the physiologic conditions. That obviously calls for small amounts of one-tenth to one-fourth per cent HCl more or less continuously throughout the period of gastric digestion. If a larger dose were poured into the stomach at one time, it would probably pass right out through the pylorus and, in case it were not completely neutralized by the bile and pancreatic juices, might actually do harm through acidification of loops of small intestines. As some of this and the following physiology will not be acceptable to certain specialists in physiology, let me confess that inasmuch as my special training has been in anatomy, I cannot bring myself to accept any physiology which does not rest on a firm anatomic foundation. For any interested in a more detailed why than can be entered into in this brief discussion of the abdominal physiology herein accepted, let me refer them to Pitzman's Fundamentals of Human Anatomy.

"My suggestions as to dosage therefore would be 20 to 30 drops dilute HCl and pepsin in a full glass of water, gradually sipped and repeated at half-hour intervals until the stomach had probably emptied itself. After the big meal of the day this would obviously ordinarily call for at least 4 to 6 glasses. For those timorous about the dosage advocated my suggestion would be to start with 10 drops, but to continue the glass at half-hour intervals throughout gastric digestion. For further reassurance there are a number of authenticated cases of physicians, sufferers from achylia gastrica, who have taken 2 to 3 teaspoonfuls of dilute HCl daily over periods of years with, so far as noted, only benefit. As it takes over 20 drops of dilute hydrochloric acid before excess free hydrochloric acid appears in an ordinary glass of milk, the dosage advocated strikes me as distinctly conservative, erring rather on the side of under- than overdosage." (Pitzman.)

4. *Arsenic.*—This is an old and well-tried remedy. That it continues in use is its best recommendation. Let us remember that McPhedran's patient, who went 18 years without a remission, took 45 minims of Fowler's solution daily. Bohan recommends using Fowler's solution, beginning with 3 drops three times a day, and gradually increasing the dose to 12 to 15 drops three times a day. The use of arsphenamine intravenously or sodium cacodylate is not to be advised: their action is brief and not comparable to the sustained and even effect of Fowler's solution when given by mouth.

5. *Splenectomy* was first suggested by Eppinger in 1913 because he believed pernicious anemia was due to an increased blood destruction. Since then it has been performed many times. There is no question but that it brings about a prompt intermission; however, no real cures have ever been reported, and it may quite definitely be said to be too dangerous and too valueless a procedure to recommend.

6. *Intestinal Intoxication.*—I have nursed so many enthusiastic young clinicians through attacks of belief in the intestinal origin of pernicious anemia that the pristine loveliness of the subject begins to pall. There is nothing better calculated to keep a young man engaged and deliver him from the crafts and assaults of the devil than to direct his mind upon this problem. There is one thing certain—if he begins to investigate the intestine in pernicious anemia he will find plenty of data. Trichomonas intestinalis will be present in abundance. An excess of Bacillus Welchii will be made out. A kind of anemia can be produced

by injection of Bacillus Welchii toxin in large quantity. Q.E.D. Ridding the colon of germs and parasites by colonic irrigations of hydrogen peroxide or gentian violet has been attempted.

## POLYCYTHEMIA

This remarkable disease is characterized by an enormous increase in red blood corpuscles. In treating it the methods we have to cause blood destruction are utilized:

1. Benzol.
2. Repeated bleedings.
3. X-ray over marrow, etc.
4. Intravenous saline.

It is so rare that reports of results by any method are valueless.

## DISEASES OF THE BLOOD ASSOCIATED WITH ENLARGEMENT OF THE SPLEEN

The student of disease should familiarize himself with the pathology, symptoms and diagnosis of these conditions first because general knowledge of them is rather deficient, but mostly because they are one group of blood diseases in which complete cure can be accomplished. I have not here space, nor is a book on therapeutics the proper one, for a discussion of the pathology and the not by any means clear pathogenesis of these diseases.

### Banti's Disease

Pathologists are considerably at variance as to whether Banti's disease is an entity or not; the pathologic findings are either non-specific in character, or vary from different laboratories. The findings, of course, also vary at different stages of the disease.

Clinically, however, it is a sufficiently well defined syndrome. It occurs in young adults, the symptom which most frequently brings them to the physician being hemorrhage from the stomach. The anemia is of a secondary type; a large number of nucleated red cells is the rule.

The only effective treatment is splenectomy. In 1917 Krumbharr, Pearce and Frazier collected 183 cases so treated with 28 deaths (a mortality of 15.4 per cent). Splenectomy usually results in permanent cure. In my own records is the case of a girl, aged fourteen, who had a gastric hemorrhage and was operated upon in 1911. She made a prompt recovery from her anemia and liver cirrhosis and is still living and perfectly well (1923). On the contrary, while in the army service,

I found in a ward one night a young man who had just had a severe hemorrhage from the stomach. On examining him I found an enormous laparotomy scar, and he gave me the history of a splenectomy for Banti's disease two years before at the Mayo Clinic. He had still an enlarged liver and a secondary anemia, although he had been perfectly healthy in the interim between operation and the hematemesis when I saw him. He improved on rest and iron and was given a discharge.

The therapeutist must always remember when confronted with a patient with the syndrome of Banti's disease that syphilis of the liver and spleen gives an identical picture.

### Hemolytic Jaundice

Hemolytic jaundice, a remarkable disease, which runs in families, and is probably identical with the disease called hypertrophic or Hanot's cirrhosis of the liver, manifests itself by cycles of intense destruction of red cells. It is entirely cured by splenectomy. About a hundred cases are now on record with only 5 deaths. The operation should not be done in a period of exacerbation. Mayo lost his only fatal case under such circumstances. The bone marrow (the regenerative force) being unimpaired, the blood quickly returns to normal. These cases are the strongest evidence we have that the function of the spleen is to destroy red blood cells.

### Gaucher's Disease

Gaucher's disease, a rare and extraordinary condition, does not necessarily cause any changes in the blood at all. Neither is it incompatible with good health. There is a case reported of a woman with an enormous Gaucher's spleen living to the age of fifty and playing tennis and going in bathing in the ocean at forty-five. The disease is distinguished by a very large spleen and liver and the presence, not only in the spleen but also in the liver and lymphatics of very large vacuolated cells. The nature of these cells is obscure and in great controversy. The student is advised to consult the original literature.

When the state of the patient demands it, splenectomy should be done. The mortality in the reported cases is high.

## LEUCEMIAS

"As a result of recent developments in the methods of treatment, the outlook for the leucemias has become much brighter and in the chronic cases if seen moderately early there is every likelihood of being able

to secure for the patient periods of remission entailing many months, or even several years of comparatively comfortable existence."

This sentence is quoted from one of the recent authoritative systems of medicine in the section on leucemia.

The means at command are:

1. **X-ray.**—See chapter on Radiotherapy. The spleen will shrink very strikingly, and the white count fall from 500,000 to 10,000 in ten days under proper radiation. Some patients are preserved in good health for three or four years.

2. **Radium** in proper doses seems to have even prompter results than the x-ray. In the myeloid forms of leucemia the results are better than in the lymphatic forms.

3. **Benzol.**—The results with benzol in both myelogenous and lymphatic forms are irregular. At times it brings prompt symptomatic relief, at times none. It should be used only when the x-ray or radium are not available and then only when careful checks on the leucocyte count can be made.

4. **Splenectomy** in myeloid leucemia has been given thorough and repeated trials and no benefit has ever been received.

### The Pseudoleucemic Anemia of von Jaksch

This disease affects only infants and is characterized by a diminution in the number of red cells, and in hemoglobin, by a leucocytosis and an enlargement of the spleen. It is not a sharp hematologic clinical entity and much debate has centered upon it. It may be a result of rickets, scurvy or congenital syphilis. When it is, the causative disease should be treated. Most cases of von Jaksch's anemia recover. Medical treatment does no good. Splenectomy is reported as successful. I find, curiously, no record of a case being treated by x-ray over the spleen. Theoretically this should be worth trying.

### Hodgkin's Disease

Much the same thing that was said about leucemia can be said about Hodgkin's disease. No cases of cure are on record, but prolongation of life and remission of symptoms and signs will occur under medical treatment. The means employed are:

1. **X-ray and Radium.**—The technic is described in the chapter on Radiotherapy.

2. **Arsenic** in the form of Fowler's solution.

Surgery is not to be recommended although Bunting, who has had a large experience, makes the surprising statement in a recent contribution to a system of medicine that it is the only valuable method we have. The glandular enlargement always recurs after surgery. It recurs after x-ray too, but this does not involve the pain, discomfort and scarring involved in an operation.

The use of a vaccine, prepared from the diphtheroid organism so constantly found in Hodgkin's glands has been disappointing.

## HEMORRHAGIC DISEASES

**I. Coagulation of the blood occurs** as the result of the formation of fibrin. Fibrin, which does not exist in the circulating blood originates from a globulin existing in the blood known as fibrinogen. Fibrinogen is probably found in the liver. Fibrinogen forms a clot when acted on by thrombin. Thrombin does not exist as such in the blood. Upon the manner of its origin occur most of the controversies in regard to the mechanism of blood clotting. The mother substance of thrombin is called by various names—usually prothrombin. It is agreed that calcium must be present to form thrombin. If calcium salts are thrown out of solution (as by oxalates) the blood will not clot. Calcium and possibly another substance act upon prothrombin to form thrombin. Prothrombin may have its origin in the blood platelets. The blood platelets rapidly disappear in a sample of blood on exposure to the air. It is possible that they liberate prothrombin as they dissolve. The "other substance" which acts upon prothrombin with calcium to cause thrombin formation is highly speculative. It may be in tissue juices. It has been called thromboplastin. Thromboplastin is a definite chemical substance found in brain tissue and lung tissue in large amounts. There is still another possibility that a substance, antithrombin, holds the prothrombin in neutralization in the circulating blood only to release it on exposure to the air.

The process of coagulation may be summarized thus:

*Step I.* Antithrombin neutralized by platelets after their dissolution. Prothrombin is then formed when its fixation substance is removed.

*Step II.* Thromboplastin [formed from platelets (?)].

$$\left.\begin{array}{l}\text{plus}\\ \text{Prothrombin}\\ \text{plus}\\ \text{Calcium}\end{array}\right\} = \text{Thrombin.}$$

*Step III.* Thrombin acting on fibrinogen forms fibrin.

In the treatment of hemorrhagic diseases we may employ the following means:

| | |
|---|---|
| Calcium: | Used properly only in calcium deficiency, as in scurvy. |
| Horse Serum: | Used when thrombin or perhaps thromboplastin is needed. Exact action doubtful. Hemophilia. |
| Thromboplastin: | Used when antithrombic substances are in excess, as in jaundice. And when platelets are reduced, as in purpura. |
| Coagulin: | Said to be prepared from platelets and to contain thromboplastic substances. Used same as thromboplastin. |
| Transfusion of whole blood: | To supply blood platelets used in purpura hemorrhagica and hemorrhagic disease of the newborn. |

It should be noted by the student that coagulation time and bleeding time are not synonymous. Coagulation time is the length of time it takes a sample of blood outside the body to clot. Bleeding time is the length of time bleeding will take place from a skin puncture as on the ear. Such a skin prick should bleed not longer than three to fifteen minutes. In purpura hemorrhagica it may bleed an hour. In some diseases, notably purpura, the bleeding time may be prolonged with normal coagulation time.

TABLE XXVI

HEMORRHAGIC DISEASES: (AFTER OTTENBERG)

| DISEASE | COAGULATION TIME | BLEEDING TIME | BLOOD PLATELETS | TREATMENT |
|---|---|---|---|---|
| Hemophilia | Enormously prolonged | Normal or prolonged | Normal | Serum or thromboplastin. Treatment of Anemia. |
| Hemorrhage of newborn | Greatly prolonged | Prolonged | | 5 c.c. whole blood subcutaneously. |
| Purpura Hemorrhagica | Normal | Greatly prolonged | Greatly decreased | Coagulen. Transfusion. |
| Purpura secondary: Jaundice, Chloroform, Scurvy. | Prolonged Prolonged Normal | Prolonged Normal | Normal | Thromboplastin and calcium. |
| Purpura Simplex Arthritic Visceral | Normal | Normal | Normal | Symptomatic. |

### II. Purpura Hemorrhagica

The distinguishing feature of purpura hemorrhagica is the diminution of the blood platelets. This condition may be brought about by diseased conditions, or destruction by toxins of the bone marrow cells—the megakaryocytes. Blood transfusion is the only treatment of value. Large amounts should be given. It may be a true life-saving procedure.

### III. Secondary Purpura

Occurs in a variety of conditions. Treatment will depend upon the cause but transfusion should always be held in reserve.

### IV. Hemophilia

An hereditary disease of males, transmitted in the female line. The coagulation time is greatly prolonged. Treatment consists in prevention of exposure of the individual to hemorrhage—surgical operation, trauma, etc., and the arrest of hemorrhage when it occurs. Under this second heading it is to be remembered that hemophiliac blood does eventually clot. The use of suture, packing, styptics, transfusion (danger of hemorrhage in venepuncture wound to be remembered) and injection of thromboplastin, etc., is advised.

### V. Hemorrhagic Disease of the Newborn

This disease which occurs during the first week of life most often on the second, third or fourth day, consists in spontaneous hemorrhages into the mucous membranes and especially into the skin; hematuria may occur; at autopsy clots are found in the gastrointestinal canal, inside the peritoneum and in the subdural spaces.

The cause is not entirely agreed upon. Syphilis was blamed for a time and is sufficiently important to be remembered; a Wassermann should be done in all cases, after the acute symptoms have been improved, and treatment carried out if necessary. Severe infection can sometimes be blamed. Schloss and Comiskey believed that there is some defect of the vessel walls which allows of diapedesis. In 1908 Lambert, Carrel and Brewer announced a cure of a case from transfusion. Many subsequent reports have been made. It is hard to reconcile the idea that there is a defect of the vessel walls with the fact that transfusion benefits the patient. There is almost certainly a congenital defect in the formation of some element in the clotting process. Whipple after considerable experimental work decided that it was due to lack of prothrombin; he proved that the coagulation time was delayed.

**Treatment.**—In many cases the subcutaneous or intramuscular injection of whole blood is effective. The father or mother is used as donor.

A tourniquet is put on an arm of the donor and 5 to 10 c.c. of blood removed from the median basilic vein. The needle is withdrawn and immediately thrust into the biceps or quadratus muscle of the little patient, and the blood injected before it has time to clot. This is very valuable because it can be done easily and immediately, when transfusion cannot, and a desperate situation tided over. The procedure should be repeated every 8 to 12 hours. As much as 30 c.c. or more of blood may be given.

**Transfusion.**—In desperate or serious cases, however, only transfusion can be relied upon. Vincent, after a large experience, says that whole blood injected may do for the mild cases, but more and more experience teaches that transfusion is to be preferred in all cases.

The disadvantage of transfusion lies in its enormous technical difficulty in newborn infants. The basilic, the jugular and the frontal sinus veins may be used.

If the frontal sinus is used the needle should be inserted at the posterior angle of the anterior fontanelle; it should be pointed backward, and kept exactly in the line of the sagittal suture.

Vincent reports 31 cases so treated with 4 deaths.

Welch used normal human blood serum, 30 c.c. two or three times a day for seven days, successfully in 12 cases.

## References

### *Diseases of the Blood*

Jolly: Recherches sur la formation des globules rouges de mammiferes, Arch. d. Anat. Micr., 1906-07, ix, 133.
Schridde: Ueber Regeneration des Blutes unter normalen und Krankhaften Verhältnissen. Centralbl. f. allg. Path., v. Path. Anat., 19:865, 1908.
Sabin: On the Origin of the Cells of the Blood, Physiological Reviews, 1922.

### *Pernicious Anemia*

Minot and Murphy: Treatment of Pernicious Anemia by a Special Diet, Jour. Am. Med. Assn., August 14, 1926, lxxxvii, No. 7.
Also the same authors and their coworkers on the same subject. Jour. Am. Med. Assn., April, 16, 1927, lxxxviii, No. 16, and September 3, 1927, lxxxix, No. 10.

### *Transfusion in Pernicious Anemia*

Anders: Trans. Assn. Am. Physicians, 1919.
Minot and Lee: Boston Med. and Surg. Jour., 1917, clxxi.
Weber: Deutsch. Arch. f. klin. Med., 1909, xcvii, 165.

### *Other Methods*

Barker and Sprunt: Jour. Am. Med. Assn., Dec. 8, 1917, lxix, 1919.
Bohan: Jour. Missouri State Med. Assn., 1922, xix, No. 11.
Hunter, Wm.: Brit. Med. Jour., 1922, p. 421.
McPhedran: Am. Jour. Med. Sci.. 1910, clx, 261.
Pitzman: Jour. Missouri State Med. Assn., December, 1922.
Roblee: Splenectomy in Pernicious Anemia, Jour. Am. Med. Assn., 1915, lxiv, No. 10.

### *Leucemia*

Billings: Benzol in Leucemia, Jour. Am. Med. Assn., Feb. 15, 1923, lx, No. 7.
Peabody: Treatment of Myelogenous Leucemia, Boston Med. and Surg. Jour., 1917. clxxvii, 873.
Stengel and Pancoast: A New and More Rational Method of Treatment of Leucemia by the X-ray, Jour. Am. Med. Assn., 1908, 1, 1317.

### *Hemorrhagic Diseases*

Addis: The Pathogenesis of Hereditary Hemophilia, Jour. Path. and Bacteriol, 1910-11, xv, 427.
Duke: Pathogenesis of Purpura Hemorrhagica, Arch. Int. Med., 1912, x, 445.
Helmholz: The Longitudinal Sinus as the Place of Preference in Infancy for Intravenous Aspirations and Injections, including Transfusion, Am. Jour. Dis. Children, 1915, x, 194.
Howell: The Coagulation of the Blood, Harvey Lectures, 1918.
Howell: The Condition of the Blood in Hemophilia, Thrombosis and Purpura, Arch. Int. Med., 1914, xiii, 76.
Minot: Pathologic Hemorrhage, Med. Clin. N. Am., 1918, i, 1103.
Vincent, B.: Treatment of Hemorrhagic Disease of the Newborn, Arch. Pediat., 1912, xxix, 887.
Whipple: Hemorrhagic Disease: Antithrombin and Prothrombin Factors, Arch. Int. Med., 1913, xiii, 637.

## CHAPTER XVIII

## THE TREATMENT OF DISEASES OF THE CARDIO-VASCULAR SYSTEM

### I. TREATMENT OF DISEASES OF THE PERICARDIUM

For therapeutic purposes the diseases of the pericardium may be considered as (1) those cases in which a simple fibrinous pericarditis is present, (2) those in which a pericardial effusion occurs, (3) those in which the effusion becomes purulent, and (4) those rare cases in which adhesions form between the parietal and visceral layers of the pericardium.

In the fibrinoplastic form, the only treatment save that directed towards the etiologic condition, is counter irritation. Most of these cases go on to resolution without benefit of therapeutics. In point of fact the existence of most of them is never suspected even by very astute diagnosticians. The relief of pain therefore is seldom indicated. Counter irritation may be made in the form of dry cupping or scarification, ice bag or ice coil or blisters with cantharidal plasters. I have found a belladonna plaster put on in the manner described by Sir Lauder Brunton, to be very effective.

"In putting on such a plaster, you must be careful that it is cut so that it can fit close to the heart. It is generally used in cases of women, and if put on without a cut or two in it, it will not fasten firmly over the breast; but by making a cut or two in it with a pair of scissors, you can manage to make it fit quite comfortably over the breast."

In pericardial effusion tapping may become necessary. The studies of Williamson are valuable in teaching us the gross anatomy of pericardial effusions. He found that the fluid accumulates first along the lower margin of the heart and about the apex, and therefore he advocates that for the purpose of reaching small amounts of fluid the most appropriate sites for puncture are just outside the apex or in the chondroxiphoid angle. The needle may also be inserted in the fourth or fifth interspace either to the left or the right border of the sternum. Tapping should be done with a somewhat blunt needle attached to a 50 c.c. syringe. The largest amount of fluid Williamson was able to inject into the pericardium of a cadaver was 650 c.c., but probably in a living body with elastic pericardial walls more can accumulate, but rarely more than 30 to 40 c.c. are obtained by aspiration. Gibson is said to have removed a

gallon of fluid from a pericardium obtaining an ultimate recovery. The prognosis of pericardiocentesis is not good, Mignon's statistics showing a death rate of 65 per cent, but it is to be remembered that the operation is usually undertaken at a late stage in the disease.

In those cases due to rheumatism the salicylates may be pushed with benefit, particularly their intravenous use.

In the pericarditis of chorea, sodium cacodylate often acts with good effect. Dr. Billings' recital is very impressive on this point:

"In 1905 I saw in consultation a boy, aged 10, who had acute rheumatic fever associated with a severe type of chorea and pancarditis, including pericarditis with serofibrinous effusion. The boy's condition was very serious. The first twenty-four hours 8 grains of sodium cacodylate was given subcutaneously in divided doses. Within thirty-six hours there was a marvelous change manifested by subsidence of the chorea, the disappearance of the fever and swollen joints and a practical resolution of the effusion within the pericardium. The drug was discontinued, and within another thirty-six hours there was a complete recurrence of all the symptoms, including a renewal of the effusion within the pericardium. The drug was again given in the same dosage, and after the subsidence of the acute manifestation, which occurred again within forty-eight hours, it was continued in somewhat smaller dosage for a week longer. Since that time I have continued to use the drug with the same positive good results in acute rheumatic pericarditis with effusion. Since then I have not found it necessary to perform paracentesis of the pericardium."

Pyopericardium, a rare condition, is surgical, as is the condition of adhesive pericarditis, described more in detail in the chapter on cardiac failure; operation is only to be undertaken in these cases in the event of heart failure.

## II. ENDOCARDITIS

Endocarditis may be due to a variety of exciting causes—the organism of acute articular rheumatism, the organism of chorea, the pneumococcus, rarely the gonococcus, the bacillus typhosus and others. The treatment of these conditions is the treatment of the underlying cause or if there is any special precaution, it is referred to in the sections in complications of these respective diseases. The disease usually meant when the name endocarditis is used (or subacute infective endocarditis, or malignant endocarditis, or chronic endocarditis) is due to streptococci (either Streptococcus viridans or Streptococcus hemolyticus). Occasionally the clinical course, particularly of the pyemic form, may be caused by the Staphylococcus pyogenes albus.

### Treatment

The prognosis is usually bad, although occasionally recovery from what seems a bonafide case occurs. The measures of value are:

**Rest** in bed under the most favorable hygienic circumstances.

**Diet.**—Soft or liquid.

**Hydrotherapy.**—Daily tepid sponging.

**Removal of the Foci of Infection,** particularly from the tonsils and teeth. One of my cases with a repeated positive blood culture, recovered after the removal of two badly infected teeth.

**Drugs.**—Aside from symptomatic treatment, several drugs have been used more or less with the idea of sterilizing the blood stream. Sodium salicylate intravenously, magnesium sulphate 10 to 20 per cent solution intravenously, arsphenamine, and sodium cacodylate, 40 grains (2.60 grams) intravenously, have all been tried and success reported. Capps has reported eight cases treated with sodium cacodylate daily over long periods; two died, four recovered, and two were improved.

**Vaccines** have not been successful.

## III. THE TREATMENT OF ANGINA PECTORIS

In spite of all the contributions to the literature of angina pectoris since 1768, Heberden's original description of the treatment leaves little to add:

"Quiet and warmth and spiritous liquors help to restore patients who are nearly exhausted, and to dispel the effects of a fit when it does not soon go off. Opium taken at bedtime will prevent the attacks at night. I know one who set himself a task of sawing wood for half an hour every day, and was nearly cured. In one also the disorder ceased of itself. Bleeding, vomiting and purging appear to me to be improper."

Set beside that, a modern paragraph by Dr. Herrick:

"The first case of angina pectoris that we ever saw was .................... in the Cook County Hospital, Chicago. The effect of amyl nitrite was marvelously helpful. It took many years of trial, with many disappointments, to drive out the notion—so firmly had it been fixed in mind by this experience and by the spell of Lauder Brunton's writings—that nitrites were practically specific in relieving the phenomena of an attack. But sooner or later one learns that while some attacks may be aborted or shortened by the nitrites or nitroglycerin, others do not respond in the least. But it should always be tried. Morphine is, of course, valuable for the pain. The other remedies that seem to have real value are the iodides and digitalis. Surely in some instances the

long continued use of the iodides lessens the frequency and severity of the attack even in the nonsyphilitic.

"Romberg has laid especial stress on digitalis in angina. This seems to us just. One may speculate as to how this result is brought about; perhaps it is due to an improvement in coronary circulation. But certain it is that under its use, even though the blood pressure may be high, some patients with angina show distinct improvement."

The nitrites, the iodides and digitalis have all been introduced since Heberden's day, but he has an antispasmodic drug in his "spiritous liquors," an analgesic drug in opium, and in the picture he paints of that particular old gentleman who sawed wood, and whose coronary arteries have long since mingled with the soil of England, we have a hint of graduated exercise.

Upon what theory of pathologic anatomy (or pathologic physiology) we are to treat angina it is difficult to say. The finest clinical minds of every generation have concerned themselves with this problem without agreement. Jenner's dissection of John Hunter showed that there was a sclerosis of the coronary arteries and that idea of the cause of angina prevailed for a hundred years. Some cases unquestionably are of that nature. Thrombosis of the coronary arteries as pointed out by Herrick, will cause anginoid pain. Clifford Allbutt's two large volumes are devoted to the demonstration that angina is caused by an inflammatory process in the aorta. Mackenzie believes that it is an expression of a failing myocardium. The fact that the pain comes on with exertion indicates this; and there is a distinct variety of angina, accompanied by irregular pulse and dyspnea which is relieved, if relief is possible, by digitalis and rest. Willius's patients who had a negative T wave, studied electro-cardiographically, showed a mortality of 70 per cent in five years. Undoubtedly there is no single cause for it and it may be due to any of these things.

Undoubtedly too, there is created an extremely sensitive focus in the spinal cord which will set off pain impulses on stimulation from any spasmodic or irritable source. How else are we to explain such things with which everyone who has treated angina is familiar, as spasms of angina produced by a draft of air blowing over the patient's bare chest, or the induction of an attack by the raising of the left arm? Gall-bladder spasms, trigeminal neuralgia, and bad teeth may all be factors in bringing on these attacks. A careful analysis of the history, the patient's habits, and the physical examination, should be made to determine the sources of origin of each individual patient's angina and treatment instituted along appropriate lines.

**The Treatment of the Acute Attack.** Rest, even immobility, will usually instinctively be induced by the patient himself. Of drugs, the

nitrites have the first choice and are usually effective. Amyl nitrite in pearls may be carried by the patient and broken and inhaled from the handkerchief when the attack occurs. Nitroglycerin may be used hypodermically, but is even more effective dissolved on the tongue. Tablets of $1/100$ of a grain may be used in this way. They may be repeated frequently. Dr. Fletcher Ingals, himself a sufferer, tells of a patient who took 100 of the $1/100$ grain tablets of nitroglycerin in one day, relieving a severe angina, and stopping all attacks for three years. Some patients who on days of severe attacks take large amounts of nitroglycerin are free from pain the following day. The tolerance of the patient to the drug may be tested by the physician on the patient in his office. In this way the patient learns of the flushing of the face and possible dizziness. The effect of the nitrites does not seem to pass off with prolonged use.

In some cases they are not effective and morphine or opium can be used.

### Treatment of the General Condition Between Attacks

(1) Rearrangement of the patient's life. There is no condition about which it is so difficult to formulate hard and fast rules. The physician's judgment will be taxed to the utmost to plan the proper procedure. No disease needs to have its treatment so thoroughly individualized. One patient needs complete rest. Another patient is flabby and needs graduated exercise. One patient needs to have his apprehensions quieted. Another needs to be impressed with the seriousness of the condition. In general, freedom from mental and physical strain, rest and peace are most needed. Attacks of anger and temper bring on spasms as the famous remark of John Hunter emphasizes.

The new ordering of the patient's life is the most important feature of the treatment. The patient may usually be told that if he is content to bank his fires, limit his activities and rearrange his habits, he may look forward to a life of several (even as many as 20) years, in moderate or complete comfort. Often a cessation of attacks will occur for many years. The severe crippling forms are in the minority.

(2) Use of tobacco is to be forbidden. Tobacco particularly is an originator of attacks. Giving up its use alone may serve to banish attacks. Great caution must be exercised in allowing patients to return to its use. One of my patients who had given up tobacco and remained for some years free of attacks, decided to smoke a cigar one evening; two puffs induced an attack in which he died. Alcohol is to be permitted with caution. Tea and coffee are probably beneficial.

(3) Graduated exercise: Judgment must be used in prescribing exercise too. Some patients need complete rest. Heberden's patient sawed wood. The exercise should be milder than that. Walking and golf allow

of infinite variations in graduation and can be recommended for that reason.

(4) Removal of infective foci and spasmogenic points. Infected teeth, gall bladders and tonsils, should be removed. Neuralgic points, trigeminal neuralgias, etc., should be treated. Relief for many years often follows such procedures.

(5) Drugs: Digitalis and iodide of potassium may be used routinely between attacks. Euphylline is probably the most successful drug for regular use. After the first attack it should be used regularly whether the attacks recur or not. Supervision of its employment must of course be left in the hands of the physician. Theophylline and diuretin have somewhat the same action as indeed do tea and coffee. Euphylline is also sold under the names metaphylline and theophylline-ethylenediamine. The dose is 1½ to 3 grains three to four times a day. Read Musser's article listed below as a guide.

### Special Forms of Angina

**(1) Cardiovascular syphilis,** particularly aortitis may initiate angina, in fact may be angina. When indicated, antiluetic treatment by iodides and mercury may be given intensively. Arsphenamine or neoarsphenamine should not be used save in very small doses.

**(2) Diabetes** may predispose to angina. The pathology is probably similar to the pathology of diabetic gangrene, i.e., the bad effect which diabetes has upon arteriosclerosis. The combined treatment of the diabetes and the angina is not mutually contradictory.

**(3) Angina Abdominis.**—No special treatment of this is indicated, but it is well to remember that it can occur and present a difficult diagnostic problem.

**(4) Pseudoangina. Spurious angina.** All pains in the chest are not angina pectoris. Focal infections, pleurisy, pericarditis and many other conditions may cause them. When other organic disease is absent and the pain closely resembles angina, they may be caused by tobacco, or by apprehension (the recent death of a friend who had angina). Sir Clifford Allbutt has said, "Pseudoangina is pseudodiagnosis." The treatment of pseudoangina, provided one is sure it is present, is psychotherapy and abstinence from tobacco.

## IV. THE TREATMENT OF DISEASES OF THE ARTERIES

### 1. Arteriosclerosis, Hypertension, Hypertensive Cardiovascular Disease, Hyperpiesis

**1. Definitions.**—The treatment of arteriosclerosis is determined largely by the attending therapist's opinions as to its cause and nature. Inasmuch as it is probably the most common of all diseases and every kind of

a specialist is brought in contact with it, and inasmuch as differences of opinion are not unapt to arise in this somewhat unstandardized world, it is hardly surprising that these above mentioned opinions of therapists are not entirely in agreement. I append below, in very concentrated form my own articles of faith upon the subject, meanwhile warning all and sundry that they are wholly my own, and would probably incur the disapprobation of 90 per cent of the incumbents of chairs of medicine, pathology, therapeutics and allied subjects in the universities of the civilized world.

Changes in the elasticity of the arterial walls can cause high blood pressure. But arteriosclerosis of the peripheral arteries can occur without rise in blood pressure. Arteriosclerosis and its accompanying hypertension is not a disease, but is the normal biologic process of senescence. It occurs in some individuals earlier than in others not on account of habits or disease but purely as an hereditary trait. (Probably a dominant Mendelian characteristic.*) It is not caused by alcohol, tobacco, tea, coffee, syphilis, the eating of red meat or other proteins, sodium chloride, the strain of modern life, worry, hurry, or any acquired habit or characteristic.† It can occur without demonstrable renal change, histologic or functional, or cardiac failure, although eventually most individuals who have it die from one of three causes: renal failure, cardiac failure, or neuroarterial failure (cerebral apoplexy). It may last for many years—certainly as many as twenty—without causing any symptoms or any considerable (age and weight allowed for) disability either mental or physical.‡

Treatment is futile so far as the progress of the process is concerned, and is largely concerned with the attempt at prevention of renal and cardiac failure and of complications. The reduction of blood pressure is not a measurement of improvement.§ The treatment of hypertension should be as nearly painless as possible.

---

*The study of human heredity is nearly impossible because no experimental observations can be made. Biologists experimenting on mouse cancer and breeding cancerous mouse stock have been able to produce cancer in offspring with mathematical precision. If we could breed human beings selectively in the same way I believe that we could produce an arteriosclerotic race who would die of old age at 20, or a race who would normally live a hundred years.

†See Sir Armand Marc Ruffer's fascinating papers upon the dissection of Egyptian mummies. He found arteriosclerosis as common among them as among Europeans and he remarks that whatever it was due to, it was not due to tobacco or syphilis. And probably not alcohol! He wrote that he had done many autopsies on Mohammedans, men whom he knew had never tasted alcohol in all their lives, and that arteriosclerosis was quite as often met with among them as among users of wine and whiskey.

‡I know of two persons whom I have examined twice yearly since 1906, and who had then systolic pressures over 170 and have been that high or higher ever since. They are both perfectly healthy from a functional viewpoint. It is to be remembered that blood pressure observations have been generally done only for about fifteen years. We know little yet of the natural history of the condition. It has naturally a high mortality from the actuarial viewpoint, but of five hundred cases of hypertension whom Janeway saw only about 150 were dead at the end of eight years.

§Therapeutic literature is everywhere vitiated with this assumption. As a matter of fact, the rise in blood pressure is a compensatory process. These people are miserable when their blood pressure is low and the spontaneous onset of low pressure is a sign of impending breakup—cardiac failure or thrombosis.

**A. The Adjustment of the Patient's Mental Attitude to the Condition and the Management of His Life.**—If possible it would be better never to tell a person that his blood pressure was high. Lives have been made miserable by the few words, "Your blood pressure is 170." I entirely agree with Dr. Cabot that physicians should always tell the truth to their patients, but as nearly as possible let us have if not the whole truth which is a big order, at least the *fair* truth. It is no uncommon experience to have a patient say, "I need something for my blood pressure—it is high." "How high?" "Well, Dr. So-and-so said was high—140." That is not the *fair* truth. I believe the recital of the mathematics of blood pressure is a bad practice. Patients may be told, "Your pressure is *normal,*" or "it is satisfactory," or it is "about the same as it was."

What to tell a patient with hypertension, and what to tell him to do requires the most humanistic good judgment. And the issue is complicated in modern days by the fact that these patients get so much contradictory advice from friends, relatives and other doctors. Believing in my own above outlined Athanasian creed of hypertension, in which the strain and stress of modern life is renounced, I do not believe in "retirement from business," or for the female of the species "the giving up of social activities" (which includes everything from running for Congress to being presented at court). In general the less meddlesome the treatment the better. Re-examination of blood pressure should not be made oftener than once a year.

**B. Removal of Focal Infections.**—Before the patient is dismissed, a search should be made for foci of infection and if found, it should be removed. This may prevent aortic, myocardial, renal or cerebral involvement. The teeth will be the most likely place, the gall bladder next, the seminal vesicles next, the nose next and the tonsils last.

**C. Reduction of Overweight.**—The proportion of overweights among hypertensive individuals is very high. The reduction of this weight makes for comfort, reduces the danger of cardiac and renal strain and to some degree will cause a fall of systolic pressure. The reduction of weight should not be made too rapidly. The strict milk diets sometimes practiced do result in reduction of blood pressure but they are cruel, unnecessary and in my experience eventually harmful. The reduction of weight can be done by the adjustment of the two variables—food and exercise.

**D. Diet.**—The usual dietary regime is a minimization of protein intake. This is based upon purely theoretical grounds—that proteins cause

renal involvement and arteriosclerosis—and has no sound experimental or observational basis. It is more important to institute a mild general reduction in diet rather than in any particular article of food.

The reduction of salt and water intake has received the approbation of Dr. F. M. Allen. Allen's theory is that the high blood pressure is a compensatory process necessary to force a filtrate of water and dissolved salt through a damaged and partially blocked glomerular filter. He has shown that there is a high level of plasma chlorides in the blood and that the reduction of chlorides is proportional to the lowering of the salt intake. Following the reduction of salt in the diet, the water intake is instinctively lowered and the blood pressure falls. This unquestionably happens. Table XXVII indicates the reduction which occurred in some of these cases.

Table XXVII

| Before Treatment | | After Treatment | |
|---|---|---|---|
| Average Systolic B.P. | Diastolic | Systolic B.P. | Diastolic |
| 200 | 110 | 170 | 90 |
| 180 | 90 | 160 | 85 |
| 250 | 130 | 200 | 115 |

The treatment is obviously best adapted to the cases in the higher levels of blood pressure with some evidence of kidney involvement. Patients with a pressure of $^{170}/_{100}$ and thereabouts not only are not improved, but lose weight and color and feel weak and fatigued.

**E. Drugs.**—Drugs have little place in the treatment of hypertension. Nitroglycerin, sodium nitrite, potassium nitrite, erythral tetranitrite have all been used for the regular nitrite effect. Iodide of potassium in small doses over long periods of time improves more cases than any other drug. In many patients potassium sulphocyanate reduces the excessive pressure and induces a feeling of well being. It is prescribed in aqueous solution so that 1 dram contains $1\frac{1}{2}$ grains of the salt. This dose is given by mouth three times a day after meals, for the first week, twice daily the second week and once daily the third week.

**F. Elimination.**—Attention to the bowels and sweating with the electric light cabinet should have careful consideration.

**G. Autocondensation.**—Autocondensation with the D'Arsonval current has the recommendation of Sir Clifford Allbutt. I have never seen anything but temporary benefit and little of that result from its use.

**H. Hypertension Associated with Endocrine Dyscrasias,** such as the menopause and toxic goiters, should have appropriate treatment. (See Chapter III.)

## 2. Aortitis and Aneurysm of the Aorta and Its Branches

These two conditions are considered here together because they are different forms and degrees of the same process. Syphilitic aortitis may develop into aneurysm and the prevention of aneurysm depends upon the early recognition and adequate early treatment of aortitis. It will be profitable to consider the pathology in order to understand this relationship.

**Aortitis** may be due to several conditions. Small atheromatous plaques are frequently found in arteriosclerosis. Doubtless many infections (streptococci from the teeth, etc.) cause small inflammatory processes in the aorta. But these conditions seldom if ever cause symptoms nor are they gravely dangerous. Aortitis due to syphilis is another matter. In this condition the spirochetae attack the tissues of the aorta by entering through the perivascular channels of the vasa vasorum in the two outer coats. All layers of the artery are affected, intima and adventitia as well as media, but it is in the media that the most important changes so far as functional integrity are concerned, take place. The elastic fibers of the media are destroyed in greater or less degree, depending upon the severity of the process, and fibrous tissue is laid down in place of the elastic tissue. This naturally leads to weakening of the aortic wall.

**Aneurysm** may be considered as always due to syphilis. (There are rare cases due to mycotic organisms other than syphilis, but these are negligible for practical clinical purposes.) The inflammatory process in aneurysm is identical with that in aortitis, and the development of aneurysm as differentiated from aortitis depends upon a localized giving away of the arterial wall. Winternitz has made an important observation on this point. He found at autopsy, in a young syphilitic negro woman who died of coronary thrombosis, a very early aneurysm, in which the intima was beginning to pouch into an area of necrosis, which had largely destroyed the media and had affected the adventitia. It is the continuation of the unarrested syphilitic process which results in the highly developed aneurysm.

Vigorous antisyphilitic treatment then should be instituted in all cases of syphilitic aortitis as well as actual aneurysm. The amount of vigor with which it should be pushed will depend upon the patient's general condition. Arsphenamine will not be used in large aneurysms with great weakness and cardiac strain. Wile does not believe in the use of arsphenamine or neoarsphenamine in vascular syphilis. But the treatment should not ordinarily be left with the administration of KI alone. Mercury by inunction or intramuscular injection can be given in large doses, and small doses of arsphenamine (0.2-0.3 gm.) should be given

at intervals and the effect watched. Sodium iodide intravenously has acquired considerable reputation in the treatment of syphilitic aortitis. The solution should be made up in the strength of 1 gram to 20 c.c. of distilled water. The initial dose is ½ gram or 10 c.c. of the solution, increasing ½ gram a week in the same ratio of water up to 5 or even 7 grams.

Besides this antisyphilitic medication in aortitis, the use of rest, digitalis and such other protective measures will be used as the indications point to them.

**The Treatment of Aneurysm.**—Valsalva's treatment of aneurysm was rest, starvation, and bleeding. Substitute antisyphilitic treatment for bleeding and you have the modern formula.

The treatment of aneurysm is looked upon as too hopeless. It is true that the prognosis is exceedingly bad, and that the length of life after diagnosis is usually not more than one or two years. But I believe that it is possible to lengthen life in cases of aneurysm by proper attention to details of treatment up to many years; even arrest and symptomatic cure are not impossible attainments, (though I have never seen them). Aneurysms spontaneously healed have been met with at autopsy.

**1. Rest.**—A preliminary rest period of six weeks in bed may render the patient symptomless. The patient may get up to go to the toilet. After this, limitation of activity and reduction of physical exertion with occasional rest periods in bed at intervals, are absolutely imperative.

**2. Diet.**—A low diet has always been advised with the idea of lowering the blood pressure and allowing the aneurysmal sac to fill with blood. Tufnell's diet is as follows:

| | | |
|---|---|---|
| Breakfast | Bread and butter | 60 gm. (2 oz.) |
| | Milk | 60 c.c. (2 oz.) |
| Lunch | Meat | 60-100 gm. (2-4 oz.) |
| | Milk | 50-150 c.c. (2-5 oz.) |
| Supper | Bread | 60 gm. (2 oz.) |
| | Milk | 60 c.c. (2 oz.) |

This is undoubtedly too weakening and does not accomplish its purpose.

**3. Antiluetic Medication** should, as in syphilitic aortitis, be pushed. Too much dependence has been put on KI alone, and in insufficient dosage. In aneurysm there are living spirochetes in the walls of the aorta. The question of the use of arsphenamine arises as in syphilitic aortitis. Wile presents case histories to show that the use of arsphenamine causes immediate temporary improvement but rapid deterioration later, usually with cardiac decompensation. I have had one or two

similar experiences, but they are by no means the rule with these cases, and arsphenamine I think should be tried in small dosage, watching the result.

*Mercury* should be given at the same time and pushed to the point of toleration. Sodium iodide intravenously used in the same dosage as recommended in the section on aortitis may be helpful.

**4. Wiring.**—In sacculated aneurysms close to, and nearly perforating, the skin, a gold and platinum wire is introduced into the aneurysmal sac and allowed to coil up, 15 or 20 feet of the wire being inserted in this way. The free end is connected to the anode of a galvanic battery, and a pad under the patient's back is connected with the cathode. A current of 10 milliamperes is given for 30 minutes and then increased to 20 milliamperes if possible. This induces coagulation and tends to retard dilatation of the sac. Dr. H. A. Hare has several times reported good results with it and his papers should be consulted for details of technic.

### 3. Diseases of the Peripheral Arteries

Buerger's disease, arteriosclerotic gangrene, whether associated with diabetes or not, thrombo-angiitis obliterans, endarteritis—all these diseases which affect the arms and legs, particularly toes and fingers, have been in the past largely turned over to the surgeons. With the use of nonspecific proteins they may be said to come first at least under the supervision of the medical therapist. Twelve out of nineteen patients so treated as reported by Allen and Smithwick were able to return to work without having amputation or other radical surgical procedure. Ulcerations heal up and pain is relieved.

Typhoid vaccine, giving 125 million killed bacilli intravenously every seven days, was the method employed. This dosage may be raised to 300 million in appropriate cases. Patients are advised to drink large amounts of fluid, abstain from tobacco, keep a cradle over the legs while in bed, maintain a temperature of 100° to 110° F. under the cradle by electric lights and do Buerger exercises (alternately raising and lowering the leg) as accessory methods of treatment. After injections a chill is expected and to be desired.

## V. THE TREATMENT OF CARDIAC FAILURE

### I. Definition

Cardiac failure, using that term in its broadest sense, is the only indication for treatment of the heart. By "its broadest sense" is meant any conditions or set of symptoms which prevent an individual from performing his activities comfortably on account of his heart.

*The important thing for the physician to remember is that local dis-*

*ease, such as valvular disease of the heart, unaccompanied by signs of failure, is not an indication for treatment.*

The causes of cardiac failure are varied. It may occur in the course of an infectious disease; it may occur as the result of long-standing valvular disease, or of thyroid intoxication, of gall bladder infection, or of arteriosclerosis or nephritis. But no matter what the etiology, the pathologic physiology and even the pathologic anatomy of the myocardium is likely to be much the same. We can profitably afford, therefore, to consider the whole subject in one place, and to review first the pathologic physiology and then the forms of cardiac failure from the standpoint of etiology.

## II. The Pathologic Physiology of Cardiac Failure in Relation to Treatment

Cardiac failure may be considered as a failure of one of the functions of the heart muscle—tonicity, rhythmicity, conductivity, and contractility.

Tone is that property of the heart muscle which prevents complete relaxation during diastole. When tonicity is impaired symptoms of blood stasis occur with cough, dyspnea, râles over the base of the lungs, swelling of the feet, swelling and tenderness of the liver, and albuminuria. The pulse is regular in pure loss of tone but may be moderately increased in rate.

Rhythmicity is that property of heart muscle by virtue of which it beats regularly. The symptom of loss of rhythmicity is an irregular pulse. The symptoms and signs of blood stasis as mentioned above for symptoms of loss of tone may supervene upon the irregular pulse.

Conductivity is that property of heart muscle by which it transmits impulses along muscle bundles. When this function is impaired it is a sign of heart block and the arterial pulse becomes markedly slow.

Contractility is that property of the heart muscle in virtue of which the cells become shorter during systole. When it is impaired alternating pulse appears.

(This classification is that used by Doctor P. T. Bohan and is very useful for teaching students, especially when instrumental methods are not available.)

Because no one can treat these conditions intelligently with a closed mind there follows a brief review of the state of modern opinion about four of the prominent symptoms of heart failure.

**A. Dyspnea.**—One of the most distressing symptoms of beginning cardiac failure is shortness of breath. It is also one of the most accurate means we have of measuring the amount of failure. It varies in intensity from breathlessness under different degrees of activity, to rapidity

of breathing and difficulty in satisfying the respiratory demands when at rest. As the heart improves, this symptom improves. No other symptom so closely and invariably indicates the onset, the course, and the improvement in cardiac failure.

The cause of dyspnea is related to the normal stimulus to respiration which Haldane and Priestly showed experimentally in 1905 to be carbon dioxide in the blood acting upon the respiratory center in the medulla. The respiratory center is extremely sensitive to the accumulation of carbon dioxide, so much so that a rise of 0.2 per cent in the carbon dioxide content of the alveolar air will cause a rise of 50 per cent in the amount of air respired. Following Haldane and Priestly's work, it was shown that the center is equally sensitive not only to carbon dioxide but to any acid radicles in the blood.

Any increase in metabolism naturally tends to increase the accumulation of carbon dioxide and hence of the rate of respiration. Thus Peabody and his coworkers found that an experimental subject exercising upon a stationary bicycle and breathing into a ventilator which allowed of the expired air being measured, raised the amount of air expired from about 5 liters a minute while at rest to about 50 liters a minute when exercising to the limit of capacity. Ordinary walking about raised the minute-volume of air three times.

Interpreting this in terms of physiology, it means that an increase in oxygen consumption by the cells of the body and the simultaneous increase in the production of carbon dioxide causes an accumulation of carbon dioxide in the blood. This arriving at the respiratory center stimulates it to activity and results in an increase in the rate and depth of respiration, or in other words in the minute-volume of respiration. This increase in ventilation, however, is useless unless an increased amount of blood flows through the lung and after aeration is carried to the tissues.

Thus in a series of experiments on men doing an increasing amount of work, Boothby found *that there was a strict parallelism between the time volume of the blood flow, the time volume of the ventilation and the oxygen consumption per unit of time.**

Appreciation of this interdependence of change in metabolism, respiration and circulation is fundamental to a clear understanding of cardiac as well as other forms of dyspnea. A reference to the diagrams (Fig. 78) will give a graphic representation of this interrelation-

*We are assuming here and in what follows that the oxygen-carrying-power of arterial blood is constant. It is not quite constant, but it varies within such limits as to be almost negligible. Arterial blood ordinarily contains 18.5 per cent by volume of oxygen 18.5 c.c. to each 100 c.c. of blood. The normal resting animal uses about 5.5 per cent of oxygen in the capillaries: the 13 per cent that is left constitutes reserve oxygen. Under extreme conditions the blood can give up some of this, but probably never (except in pernicious anemia (Lundsgaard, Jour. Exper. Med., 1919) does it give up more than twice the normal amount.

ship. In a healthy body at rest these factors have adjusted themselves perfectly; if one is disturbed the others change to compensate for the difference; in each there is a compensatory ability of adjustment, a wide margin of safety. An individual doing work raises his oxygen consumption and the ventilation and blood flow also increase. The normal amount of cardiac output in a person of average height and weight is, according to the best data obtainable, 4 or 5 liters. It can be increased only about four times with exercise, and this only in the case of trained athletes. Exercise then can be continued up to the point when the mass-volume of the cardiac output has reached the limit of the heart's ability to increase it. When that point has been reached the exercise must stop.

Dyspnea then can be caused by several factors:

1. **Metabolic**—increase in basal metabolism—increase of acid bodies in the blood.

2. **Respiratory**—reduction of lung volume, i.e., from pleural effusion, emphysema, etc.

3. **Blood composition**—reduction of oxygen-carrying bodies as in anemia.

4. **Cardiac**—reduction of the output of blood per minute.

*Cardiac dyspnea* has been ably investigated upon all of these points.

**Metabolism.**—Several investigations have shown that, in cases of cardiac failure, there is some increase in metabolism. Peabody, Meyer and DuBois in the calorimeter at the Russell Sage Institute of Pathology at Bellevue Hospital, showed that in compensated heart cases the metabolism is normal, but that of 12 cases with cardiac failure 3 had normal metabolism, and 9 had an increased metabolism never ranging above a 50 per cent increase and that only in one or two instances. This work was repeated by Peabody, Wentworth and Barker on 24 patients, and demonstrated again that in those with decompensated hearts the metabolism is slightly above normal. The increase was above 25 per cent in only two cases, and was usually slight. It would not appear that these findings should be interpreted to mean that the metabolism is sufficiently increased in cardiac failure to account for the dyspnea; the metabolism in hyperthyroidism, for instance, may be 80 to 100 per cent above normal and result in no or little hyperpnea, and the metabolism after a quarter mile run must be several hundred per cent greater than at rest.

*Acidosis.*—The problem of whether the dyspnea of cardiac disease is due to acidosis has also been investigated. The only acid which is found to have accumulated in the blood in these patients is carbon dioxide. The carbon dioxide tension of the alveolar air is low, while

that of the blood is high, and as compensation is regained, this discrepancy tends to disappear and the normal status to be regained. In cardiac patients whose disease is complicated by renal disease, however, and in renal disease alone, there is a constant and distinct acidosis, accounting for the hyperpnea of these cases.

*Blood composition* in cardiac failure is unchanged, as a whole.

*Respiration.*—A factor which has been found to be altered in cardiac disease is one of the elements in respiration. Oxygenation may be ac-

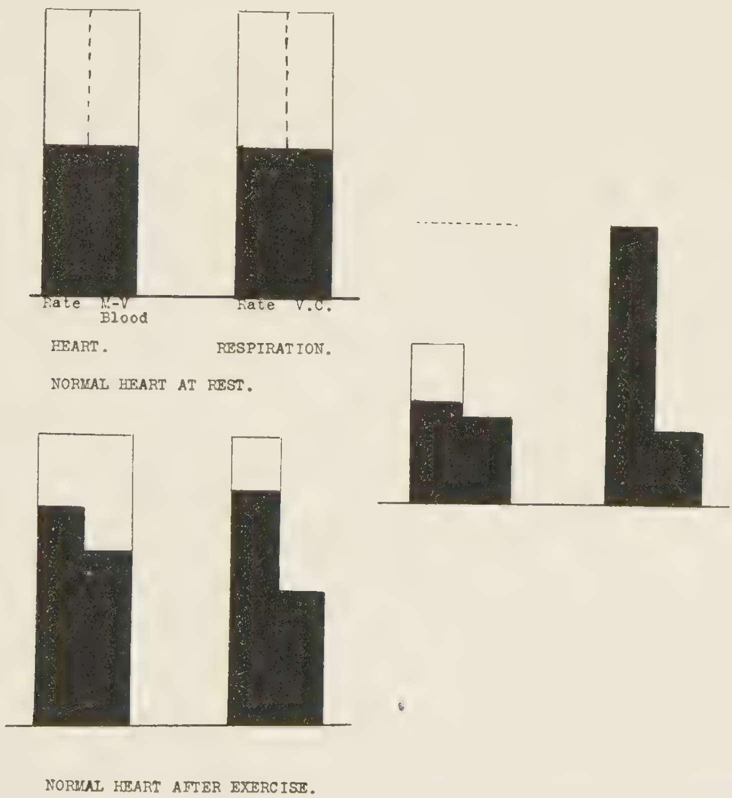



Fig. 78.—Diagram to illustrate the mechanism of cardiac dyspnea. Upper left hand figure represents the conditions at rest. The cardiac factors at left, two elements being involved, the rate of the pulse and the minute-volume of blood. The respiratory factors to the right, two elements also involved, the rate of respiration and the vital capacity. Margin of reserve indicated by dotted space above.

Lower left hand figure shows condition after severe exercise. Internal respiration is high and pulse-rate, minute-volume, and rate of respirations rise to compensate for it. The vital capacity however is lowered.

Right hand figure represents conditions with severe cardiac failure. Minute-volume of cardiac output is lowered, so is the vital capacity. The respiratory rate is greatly increased to compensate these factors.

complished both by the *rate* and by the *depth* of respiration. In cardiac failure there is apparently an inability to increase the depth, and in fact it is decreased. The vital capacity is the name given this factor in respiration. The vital capacity of the lungs is the quantity of air

that can be breathed out by the deepest possible expiration after the deepest possible inspiration. It varies with the height and weight of the individual, an average figure for an average adult man being 3700 c.c.

In heart disease the vital capacity may go as low as 40 per cent in the severely decompensated patients, and it varies according to the state of the case, being perhaps the most accurate measurement we have of the patient's improvement.

The cause of this lowering of vital capacity in cardiac decompensation is by no means easy to explain. It may be due, of course, to an encroachment on the lung volume, such as by a pleural effusion or transudate, but it occurs in cardiac cases in which there is no fluid in the chest. It is not due to general weakness, as cases of pernicious anemia in a very weakened state with dyspnea were found by Peabody and Sturgis to have only a very slight lowering of vital capacity, never more than 25 per cent. Siebeck is of the opinion that it is due to a lessened elasticity of the lung due to stasis, though this is a very unsatisfactory explanation.

*Cardiac.*—The lowered vital capacity does not, however, completely explain cardiac dyspnea. It seems to be a part of the phenomena, but not the cause. There is one thing, however, which theoretically should be present in cardiac failure, and which would explain the dyspnea in terms of the interrelation of metabolism respiration and circulation. This is a reduction of the mass-volume per minute output of blood from the heart. Naturally this cannot be directly measured. But by devising an ingenious (though not clinically applicable) experimental plan, Pearce has shown that the mass-volume per minute cardiac output in decompensated cases is about half that of normal (3 liters in one case).

This finding satisfies our theoretical conception quite well. One factor in the tetrad of factors which influence dyspnea—metabolism, respiration, blood, circulation—is definitely and necessarily changed—the mass-volume of blood from the heart is reduced. In order, then, to satisfy the metabolic demands which remain the same, the other variable factor, the respiration, must rise, and since for some reason the depth of respirations cannot be increased the rate must. At the same time the patient instinctively limits the metabolic rate by moving as little as possible.

**B. Cyanosis.**—Cyanosis occurs in heart disease only in the terminal conditions. It is, of course, due to the same condition which produces dyspnea, the lack of oxygenation due to decreased mass-volume of cardiac output and the consequent accumulation of carbon dioxide in the blood. In cases of heart disease of the congenital variety, it

results simply from the admixture of venous with arterial blood. Under certain conditions, present sometimes in pneumonia, and in pulmonary edema, a condition of anoxemia or deficient oxygen saturation of the blood as it passes through the lungs occurs, and cyanosis always develops.

The carbon dioxide tension in the alveolar air may under these conditions be little different from normal or as in the case of mountain sickness, actually lessened and yet hyperpnea and cyanosis be present.

A logical form of treatment for this particular variety of cyanosis would seem to be a concentration of oxygen in the inspired air. Of late this method of therapy has been revived, but no form of oxygen chamber yet devised seems to meet the demands of the case. The technical difficulties are discussed in the section on oxygen therapy.

**C. Edema.**—The accumulation of fluid in the tissues is called edema. In the peritoneal cavity it is known as ascites, in the chest as hydrothorax, and in the skin when general as anasarca. The tissue spaces appear from the researches of Florence Sabin to be not simply open spaces between cells but closed and lined with lymphatic endothelium and intimately connected though exactly how is not certain, with the veins. Any obstruction of the outflow of venous blood as in varicose veins, will result in edema of the skin in the region of the obstruction.

Edema, like cyanosis and dyspnea, occurs in a variety of diseases—notably nephritis. Here it seems certain that the edema is due to failure to excrete salt and water, particularly salt, which requires the retention of water and this overdistention causes fluid to seep out into the tissue spaces.

The edema of circulatory disease would appear to admit of a very simple explanation, in the obstruction of the venous return flow of the blood. All the theoretical requirements cannot quite be fulfilled in this way, however, and Haidenhain was forced to postulate a vital secretory activity of the endothelial cells. The edema of cardiac failure begins usually in the ankles, i.e., the most dependent portion of the body; later the thighs, the abdomen and the liver are involved. The enlargement of the liver is partly edema and partly stagnation of the portal circulation. It would appear that in such a chain of events the cause resides primarily in the inability of the ventricle to expel the normal mass of blood, so that the right auricle first is partly filled and back-damming occurs just behind it in the vena cavae; the superior vena cava, having the mechanical advantage of gravity, empties itself more efficiently than the lower and it is in this that stagnation occurs. The endothelial cells might well have their nutrition lowered by this stasis and become increasedly permeable.

In the treatment of this form of edema, the general improvement in

the heart by rest, digitalis and other appropriate measures will result in an immediate improvement, the fluid disappearing with magical rapidity. A dry salt-free diet may also contribute directly to its relief. The use of saline cathartics is particularly good in ascites and in "squeezing out the last drops" of fluid from the enlarged liver. Novasurol is, however, a better drug, under these circumstances. When the condition has been of long standing, the fluid does not always entirely leave the ankles even when general improvement occurs. I have found a very simple procedure to be of value under these circumstances —the tight bandaging of the ankles with a roller bandage. This should be changed daily, refitting the bandage snugly, until the ankles are normal in size, when an elastic stocking may be applied. Scarification is sometimes resorted to—it consists simply in making linear incisions through the skin with a sterile knife and applying a tight sterile bandage. Ascites may have to be relieved by tapping. Hydrothorax, which in heart disease is more often on the right side possibly due to the anatomical arrangement of the azygos veins, may be relieved by thoracentesis.

*Edema of the lungs* may occur as the result of acute cardiac failure, or in the course of an infectious disease, sometimes during an epileptic fit or in angioneurotic edema. Pathologically the alveoli of the lung are filled with fluid. The experiments of Welch, who produced it pathologically by compressing the left ventricle and thus producing a disproportion in the work of the two sides of the heart, would seem to indicate that it is caused by left ventricular failure and right ventricular preponderance.

Therapeutically the indicated drug is atropin given hypodermically in large doses. The condition is usually fatal.

**D. Irregular Pulse. Abnormal Cardiac Rhythm.**—Knowledge concerning the nature and cause of abnormalities in rhythm of the heart has been greatly increased from 1900-1920, by the use of exact instrumental methods. Information about some of the conditions is very definite—such as auricular fibrillation, sinus arrythmia, forms of extrasystole, etc. In other directions information is fragmentary and cannot by the nature of things be complete for many years, in fact until patients who have been under electrocardiographic observation for several years die and come to autopsy. Such facts as we have along these lines indicate that a form of irregularity may change in the same individual from one time to another, as the myocardial disease progresses. What these changes in rhythm mean in terms of the histologic pathology of the myocardium we have yet to learn, although we have some hints. It is with full realization of the extremely tentative nature of our knowl-

edge on this subject that I venture to classify the abnormalities of cardiac rhythm on the basis of the extent of the myocardial damage.

**A. Pulse Irregularities Which Do Not Indicate Any Myocardial Change or Cardiac Failure.**—1. *Sinus arrhythmia,* an increase in the rate of the heart during inspiration and a decrease in the rate of the heart during expiration. This is physiologic in young individuals up to the age of twenty-five and never indicates heart failure.

2. *Extrasystole.*—Premature contractions. The most common form of this is a dropped beat every three, four, or five beats of the pulse. It may last through a long life and only be discovered accidently. The cause of it is a small premature contraction which comes soon after a normal contraction and exhausts the reserve contractile power of the heart, thus necessitating a slightly longer interval for recovery. These premature contractions are usually ventricular, occasionally auricular in origin. They do not indicate myocardial degeneration or cardiac failure, although they should not be confused with the dropped beat of some forms of heart block or branch bundle block, indicating serious myocardial damage. Treatment of extrasystoles is unnecessary though quinidine sulphate by its general action may cause them to disappear. Smith found that it was helpful in 17 out of 20 patients. In a few it caused the extrasystole to disappear permanently by a few days' administration. In a few it caused only temporary relief and upon recurrence of the extrasystole readministration of the drug failed to obliterate them. In some the daily administration of a small dose was effective. Psychotherapy, by assuring the patient of the harmlessness of the phenomenon, is the best form of treatment.

3. *Sinoauricular block.*—"A peculiar disturbance of the heart's action —consisting of dropped beats—in which the auricular beat is lost as well as the ventricular" (Lewis). It may be suspected in an individual whose pulse is irregular after exercise as the rate returns to normal. It does not cause any symptoms of circulatory failure.

**B. Pulse Abnormalities Which Usually Do Not Indicate Cardiac Failure, Though Occasionally They May Indicate or Result in Cardiac Failure.**—*The Tachycardias.*—Tachycardia or rapid heart action may be continuous or paroxysmal. The continuous forms are nearly always extracardiac in origin, the most common causes being hyperthyroidism and tuberculosis.

Paroxysmal tachycardia may be due to:

1. Paroxysmal auricular fibrillation—see below.

2. Paroxysmal auricular flutter—see below.

3. Paroxysmal tachycardia. This syndrome, the cause of which is purely speculative, consists in suddenly occurring attacks of very rapid

heart action—the pulse going up to 140, 160 or 180 and remaining so for different periods of time from an hour to seven, eight or ten hours. The patient is conscious of the rapid heart action, and the onset and termination of the attack, both being abrupt, are described by such terms as, "a mallet striking the chest," "the heart turning over," etc. Aside from this the patient is not incapacitated and in spite of the very rapid heart, there are few signs of heart failure. Attacks may indeed occur for many years without leaving the heart with any obvious damage. Occasionally the attack may continue so long as to exhaust the heart, and as in the cases of cardiac upset observed after surgical operations by Levine, may result in death.

Treatment of paroxysmal tachycardia is mainly psychic. The patient is usually extremely apprehensive, particularly if the attacks are of recent onset. He has often been given a very solemn prognosis by some overconscientious medical attendant and been the object of solicitude from relatives who have seen him in an attack. It often takes a great deal to break down this barrier. A very careful physical and laboratory examination with, if possible, instrumental records, is not only necessary to the therapist but a good piece of therapy itself when the time for assurance arrives. I have found that it is very comforting to these patients to hear of other persons who have the same affection and to read them accounts of it.

Drug therapy has little effect on the attack itself or for the purpose of preventing attacks. Digitalis or strophanthus in any form is completely inert. Quinidine sulphate offers a better outlook.

The effect of posture both in bringing on the attacks and in stopping them is well known to many of the patients. The particular attitude which is effective is usually entirely individual in each case. One patient can stop an attack by running for one or two hundred yards; one by rolling over and over; one by lying with the head down; one of Rich's patients had an attack when she raised her hands above her head, and one attack was thus induced while putting on her nightgown.

Pressure on the vagus or stimulation of the vagus by pressure on the eyeball is about the most hopeful method we have of stopping an attack. The pressure should be made over the carotid packet and persisted in until obliteration of the artery is accomplished. The procedure should be repeated several times and then pressure over the eyeball begun. One or the other of these will terminate about one-third of the attacks.

4. Neurocirculatory asthenia. This is the name given to a condition very frequently observed in soldiers during the late war. It consisted of an extremely rapid regular pulse, usually in individuals of a neurotic tendency, little evidence of cardiac failure, and often a high blood

pressure. It is seldom observed in a pure form in civil practice (unless the tachycardia of hyperthyroidism is considered such).

Treatment by drugs or rest was quite futile. The pulse persisted in its high rate in spite of anything. Pressure on the eyeballs and vagus was given a good trial in my wards without success. Graduated exercises were the best treatment, previous to the signing of the armistice, which was a sterling remedy for the majority of my cases.

**C. Pulse Irregularities Which Indicate Cardiac Failure but Which Are Usually Remediable.**—1. *Auricular Fibrillation* is probably the most common cause of cardiac failure and if it lasts for any period of time will result in dyspnea, edema, enlargement of the liver, ascites, albuminuria, pulmonary congestion and cyanosis. The pulse is absolutely irregular, hardly any successive two beats being of the same force or duration. The cause of the phenomenon is the cessation of rhythmic beats on the part of the auricle, the auricular muscle going into a state of quivering tetany. In this condition it sends totally irregular impulses to the ventricle which thus beats at such times as are determined by (1) the strength of the wave reaching it from the auricle and (2) its own contractile state (or in other words its rest period after a previous contraction). It is well to remember that the condition may be quite transitory and short in duration—paroxysmal auricular fibrillation—and end spontaneously. (For a more extended review of the condition see the section on Digitalis in Part I.)

In its treatment we have a specific in digitalis and the digitalis bodies strophanthus and squill (convalleria and apocynum, though of the same family, are not so certain in action). Quinidine sulphate has also been used.

2. *Auricular Flutter.*—In auricular flutter it is supposed that impulses to stimulate auricular contraction arise from some abnormal focus, that these impulses drive the auricle at an increased but regular and uniform rate. The auricle contracts from 200 to 400 times a minute, and about one-half to one-third of these beats gets through to the ventricle. It is a rare condition and occurs usually in people from 50 to 70 years of age, usually 60 to 70. In a person of this age with a pulse of 120, persisting at that rate with no change on change of position or exercise, auricular flutter may be suspected. The patient is often entirely unaware of the condition, no symptom calling attention to the heart. There may be no dyspnea, in fact there may be no symptoms whatsoever. The condition may be short in duration and pass spontaneously.

In treatment full doses of digitalis should be given. After the absorption of a good dose of digitalis, auricular fibrillation may occur for a time succeeded by normal sinus rhythm.

3. *Nodal Rhythm or Atrioventricular Rhythm* is a vary rare condition in which the rhythm of the heart originates in the atrioventricular node of Tawara. "Impulses arising in this node travel in both directions, upward to produce an upside down contraction of the auricles and downward to produce ventricular systole." (White.) It usually indicates depression of the sino-auricular node.

Atropine sulphate in large doses ($\frac{1}{30}$ gr.) has been used more successfully than any other drug.

**D. Pulse Irregularities Which Indicate Grave and Usually Irremediable Damage to the Heart Muscle.**—1. *Pulsus Alternans.*—The pulse in this condition, alternates in strength or volume, a small beat regularly succeeding a large beat. It indicates very serious myocardial damage. It occurs in arteriosclerosis, nephritis, angina pectoris and occasionally as the result of myocardial damage in infectious disease. Of White's 71 cases, 25 succumbed within ten months.

The treatment consists in the enjoinment of absolute rest, both physical and mental. The diet must be made very bland,—eggs, soups, toast, fruit, etc. Small doses of digitalis are helpful.

2. *Heart Block.*—Heart block consists in an interference with the impulses passing from the auricle to the ventricle along the auriculoventricular neuromuscular bundle of His. It may be of varying grades of completeness—from a mere slowing of the conduction time (prolongation of the a-c interval, or P-R interval) to complete block with dissociation of the auricles and ventricles, each establishing an independent rhythm. It may be functional, due to the use of drugs; the physiologic action of digitalis and the members of the digitalis group are dependent upon their ability to cause block. Or it may be due to mild and transitory parenchymatous change of the muscle in the course of an infectious disease: such things are not uncommon in the course of erysipelas or rheumatism. The severe forms occur in arteriosclerosis and syphilis. A few of the cases are due to gumma or syphilitic infiltration in the auriculoventricular bundle. In these severe forms the occurrence of fainting attacks and apoplectiform seizures—Stokes-Adams syndrome—is the rule. In the milder and more complex forms (bundle-branch block) the diagnosis can be made with certainty only by the use of mechanical devices. Slowing of the pulse, or dropped beats are always present.

Treatment of the mild forms consists in rest and waiting. They usually pass away. In fact they usually occur in the course of an acute infection, pass away and are never recognized. The fainting which occurs in convalescence from these states may be an expression of heart block.

In the more outspoken forms, *atropine* has been recommended most often. It is given hypodermically in the dosage of $\frac{1}{100}$ grain or even

more three times a day. Its action is to attempt a more rapid ventricular rate by paralysis of the vagus. It should be continued for several days, and in smaller doses, after regular rate has been established. It does not, by any means, always act, and Price states that he has seen no good from its use in any case.

In syphilitic cases, of course, iodide of potassium by mouth or iodide of sodium intravenously may be given. Mercury rather than arsphenamine should be the adjunct.

Thyroid extract and adrenalin with the obvious idea of increasing the heart rate have been used.

Barium chloride in the dose of 30 mg. three or four times a day has been used on account of its ability to induce extraventricular systoles. Caution must be exercised, as it is a poison.

Digitalis, apparently a directly contraindicated drug, has been used at times with the idea that heart block is an expression of a generalized myocardial weakness. The disease of the auriculoventricular bundle can only rarely occur alone, without other myocardial change. But digitalis should be used with great caution, and only in small doses.

3. *Terminal cardiac arrhythmias*—due to branch bundle block, myocardial degeneration, thrombosis of the coronary arteries, ventricular fibrillation and other conditions—are likely to succeed one another in the later days of a life which terminates in cardiac death. While the study of these forms of irregularity is of fascinating interest, it cannot be undertaken in a book on therapeutics as these patients are usually beyond the reach of treatment.

## III. Forms of Cardiac Failure

**A. Cardiac Failure in Acute Infectious Diseases.**—An infectious disease may affect the heart in one of three ways. It may light upon the endocardium, particularly the valvular endocardium, and leave a permanent organic defect, which may cause cardiac failure at a period many years later. Of the acute infections acute articular rheumatism is particularly likely to do this, but every infection may do so to some extent. Barach, studying 291 cases of valvular disease, found a history of rheumatism in 143, of chorea in 11, of tonsillitis in 82, of scarlet fever in 40, of typhoid in 36, of pneumonia in 23, of diphtheria in 23, of syphilis in 9 and of growing pains in 7.

Secondly, an acute infection may affect the myocardium itself, causing a necrosis or hyaline degeneration of the heart muscle fibers. Clinicians have been accustomed in these cases to use the term "myocarditis." Pathologists generally have criticized the term, because it implies an inflammation of the muscle, which, they say, is not present, but that a hyaline degeneration or parenchymatous degeneration is. Irre-

spective of the entymology of the term, both the clinician and the pathologist mean the same thing. The acute infection most likely to affect the myocardium is diphtheria. But other infections also do so to a greater or less extent. Analyzing cases which he considered to have myocardial change, Barach found that in the history of 148 such cases, 38 had tonsillitis, 29 typhoid, 23 diphtheria, 22 pneumonia, 21 rheumatism, 18 scarlet fever and 10 syphilis. This myocardial change is not always evident: so great is the reserve force of the heart that it will be able to compensate completely for the injury. After the acute infection has subsided, the myocardial injury may undergo resolution and the degenerated myocardial fibers be replaced by scar tissue. If this occurs in many parts of the myocardium, it will cause neither symptoms nor evidences of cardiac failure. If, on the other hand, it occurs in the bundle of His, it may cause very serious disability. Diphtheria is particularly likely to affect the bundle of His, and the heart failure of diphtheria is so important that it will be considered separately below.

Thirdly, what is usually referred to as the cardiac failure of acute infectious diseases is the condition which results from the overwhelming of the myocardium and particularly the arterial system with the toxins of the disease, resulting in symptoms closely related to surgical shock—rapid pulse, low blood pressure, pallor changing to cyanosis, rapid respiration, edema of the lungs, profuse perspiration, delirium, coma, suppression of the urine and finally death. It is the usual cause of death in most infectious diseases—in typhoid fever, in pneumonia, and in bronchopneumonia.

Before considering the treatment of this condition, we must try to understand the underlying physiologic pathology. Unfortunately neither experimental nor clinical studies have considerably illuminated nor are they in entire agreement as to the nature of this underlying mechanism. Whether the heart muscle itself ceases to contract wholly or in part, or whether there is a general vasomotor paralysis cannot be answered authoritatively at present. *The nature of cardiovascular failure depends somewhat upon the individual infection*—the failure of diphtheria, for instance, is considerably different from the failure of typhoid fever. These individual infections are considered separately below.

In general, however, the cardiovascular failure of infection is much the same, so far as pathologic physiology is concerned, as shock. The symptoms, for instance, which Mann considers to constitute a definition of surgical shock might well be named as the symptoms of the collapse, usually considered the cardiac failure, of the acute infections. They are: (1) a great loss of sensibility, (2) pallor of mucous membranes, (3) small weak pulse, (4) irregular rapid shallow or gasping respiration, (5) materially lowered blood presure.

The paragraphs on shock should be read in connection with the present ones.

Romberg and Pässler in 1899 recorded some fundamental experiments on the effect of the infections on the heart and vessels which are the starting point of all subsequent study. They observed the fatal collapse in 250 animals after infection with the pneumococcus, the bacillus pyocyaneus, and the diphtheria bacillus. They wanted to know whether the cause of the condition was due to the heart muscle giving away, or to the paralysis of the vasomotor centers, or to the failure of the tone of the arterial walls. In order to determine this they planned an ingenious set of experiments. They recorded in each animal the blood pressure and general condition of the circulation after 5 procedures:

1. Abdominal massage, which increased the work of the heart by supplying it with more blood.
2. Compression of the aorta above the diaphragm which makes the work of the heart maximal.
3. Irritation of the nasal mucous membrane with a faradic current which causes extreme vasoconstriction, by stimulation of the vasomotor center in the medulla.
4. Short asphyxia which causes vasoconstriction by stimulation of the vasomotor centers both in the medulla and spinal cord.
5. Injections of barium chloride which cause constriction of the arteries entirely by local action upon them.

The results of the experiments showed that in the early stages of the infections, the reaction of the heart and of vasomotor centers remained perfectly normal: the greatest rise in blood pressure resulted from the stimulation of the mucous membrane of the nose. Later when the animals showed signs of impending collapse, and the blood pressure began to fall, there was a very slight elevation of blood pressure as the result of stimulation of the nose, though a little more as the result of asphyxiation. By abdominal massage, however, the rise was as great as before. Later when the arterial pressure was at its lowest level, no rise was obtained by stimulation of the vasomotor centers, either by faradization of the nose, or by asphyxiation, but abdominal massage gave as great a rise as ever. The injections of barium showed that the paralysis of the arterial system was central and not peripheral. The animals infected with diphtheria did indeed show upon compression of the aorta above the diaphragm, a falling off of the cardiac reserve force, compared to the animals infected with pneumococcus: this, however, is simply a reproduction of clinical experience as diphtheria is recognized as having a particular affinity for the cardiac muscle. The animals with diphtheria also showed a parenchymatous degeneration of the myocar-

dium after death; but the investigators did not believe that even in diphtheria the heart muscle deficiency was enough to cause death. Death resulted in all types of infection from vasomotor paralysis.

Heineke demonstrated that collapse in perforated peritonitis was due to a paralysis of the medullary centers.

These conclusions, though in the case of surgical shock later work has caused some modification, form the basis for the treatment of collapse during an acute infection. It is directed towards raising the blood pressure by the use of adrenalin, caffeine, camphor, intravenous saline, intravenous glucose, etc. Unfortunately this mode of treatment is usually a failure. Dr. Harlow Brooks, in a recent article on the management of the heart in pneumonia, laments that so many young clinicians have become therapeutic nihilists about the treatment of cardiac failure in pneumonia. But if their observations are sound, they may well be so, because every one who has gone through a considerable experience with these cases knows perfectly well that the drug treatment is simply worthless, and the matter cannot be remedied by calling people harsh names who give voice to the truthful record of what they have seen and observed.

In the use of water I believe there is more hopefulness. In typhoid fever certainly the bath has proved its value. The wet pack or the bath in pneumonia, scarlet fever and other infections, is often distinctly beneficial, and it exerts its benefits entirely through action on the vasomotor system. If there is any therapeutic measure which deserves trial in these conditions, it certainly is hydrotherapy rather than drug therapy.

*The Heart in Diphtheria.*—Dr. Calvin Smith has given us some careful studies of the heart in diphtheria. It is worth noting that these studies are clinical. They were done upon human beings infected with clinical diphtheria, and studied by means of the electrocardiograph. Of 242 patients 28 per cent showed some heart symptom other than simple tachycardia. Most of these were the initiation during convalescence of sinus arrythmia, or sinoauricular block, or premature auricular contractions—all of which are harmless. Fifteen per cent of the patients who developed symptoms developed high-grade heart block, and all died. *In none of these patients had early adequate treatment with diphtheria antitoxin been instituted.* In this statement lies the key to the prevention of cardiac failure in diphtheria. Digitalis is naturally contraindicated. The clinical features of heart block in diphtheria make it recognizable without graphic methods. It usually begins in the sixth to eighth day of the disease. It is sudden in onset, and a very high-grade block from the beginning. Smith points out that it is not possible to discern four or five pulsations in the jugular to one in the carotid, as may be seen in the cardiosclerotic blocks of later life. The beats of

the radial pulse drop to 60 a minute soon after the onset, gradually becoming even slower. The appearance of the patient is alarming: the extremities are cold, the skin white, and there is a blanching around the mouth. Death is inevitable, usually within 24 to 36 hours of the onset.

*The Heart in Pneumonia.*—Pneumonia is somewhat different from the other infections, because the involvement of the lungs has led some clinicians to suppose that this throws an especial burden on the right heart. There is no good proof of this, and it is doubtful whether the chambers of the heart can be separated in regard to the failure of one or of the other: the heart muscle, in other words, is a unit. All the experimental work which we have leads to the supposition that the collapse of pneumonia is vascular and that the myocardium itself remains practically intact to the end. Newburgh and Porter, for instance, took four series of 10 dogs each, one-half with experimental pneumonia. "In the first the normal ventricle was fed with normal blood: in the second the pneumonic ventricle was fed with normal blood: in the third the normal ventricle was fed with pneumonic blood: and in the fourth, the pneumonic ventricle was fed with pneumonic blood. * * * The experiments show that the cardiac ventricle from dogs that have died from pneumonia contracts as well as the ventricle from healthy dogs, provided the pneumonic muscle is fed with normal blood. When a normal ventricle is fed with pneumonic blood the contractions are much impaired. If, however, the ventricle from a dog with pneumonia is fed with pneumonic blood, the contractions are almost normal in extent and may be normal in duration.

"Thus in pneumonia the heart muscle is essentially normal, whereas the pneumonic blood is distinctly poisonous to heart muscle suddenly fed with it. In the body, during the gradual course of the disease, the blood is progressively affected and the heart muscle gradually adjusts itself to the poison with striking success."

*The Heart in Acute Articular Rheumatism.*—The gravest danger to the heart from rheumatism is to the endocardium and the valves. But the myocardium may also be affected. Heart block occasionally occurs, particularly, so Christian thinks, in cases which develop a (rheumatic) acute pericarditis. Most cases recover, but the fact that this complication occurs should remind us that in the convalescence from rheumatism a considerable period of rest should be enjoined.

*The Heart in Chorea.*—In chorea as in rheumatism there is always imminent a pancarditis,—an inflammation of the valves, the pericardium and the myocardium. There is a drug which seems to be very effective in these conditions, particularly in chorea,—*sodium cacodylate.* It should

be given hypodermically in doses of 2 to 4 grains two or three times a day.

*The Effect of Syphilis on the Heart.*—Syphilis is more likely to affect the arteries than the myocardium, but gummata and gumma-like infiltrations do occur in the heart, particularly in the auriculoventricular bundle, causing heart block. The treatment is by large doses of iodide of potassium or of iodide of sodium and mercury.

**B. Cardiac Failure as the Result of Surgical Operations or Trauma.**—Here again we may be allowed to make distinctions—there are at least two forms of cardiovascular failure occurring during or as the result of surgical operations or trauma. One is the condition commonly called "acute dilatation of the heart"; the other is that commonly called "shock."

*"Acute cardiac dilatation"* has come to mean a sudden onset of rapid irregular pulse, discomfort about the heart (if the patient is conscious) rapid respirations, and in a short period of time either recovery and restoration to normal or death. No real proof has ever been brought forward that the heart is dilated. Careful instrumental study of these cases is obviously difficult. The patient may be upon the operating table in the midst of an anesthetic, or in bed afterwards become suddenly too sick to move or to annoy with examination. Levine has overcome the difficulties and has submitted nine patients with the syndrome of "acute dilatation of the heart" to electro-cardiographic examination. In each instance the mechanism of the heart beat was found to be abnormal. "Three had paroxysms of auricular tachycardia, four suddenly went into auricular fibrillation, and two had paroxysmal auricular flutter." In another study Levine measured the size of the heart in 11 cases of this kind and in only one did he find any appreciable enlargement. In all but two of the cases the condition was transient. Knowing these things, the question of treatment of these conditions is very hopeful. The term acute dilatation of the heart should be discarded. Paroxysmal auricular tachycardia should be treated by attempting to stop the attack by pressure over the left or right carotid artery, and if this fails, by pressure on the eyeballs. Both fibrillation and flutter can be treated with digitalis or strophanthus. In view of the urgent nature of the cases, intravenous strophanthine would seem to be the logical method of procedure. In distinguishing between these forms of rapid pulse without instrumental means, Levine points out that auricular fibrillation is the only one which produces an irregular pulse. The rate of auricular flutter is slowed by vagal pressure, but the rate of auricular tachycardia is usually not affected by this means unless the attack is completely terminated.

*"Shock."*—Shock may be caused by a sudden blow (particularly on

the abdomen), by a crushing or mutilating injury (such as the tearing away of a hand or foot by an explosion) or by surgical operations, particularly on the abdomen. The symptoms are much the same in all cases, and they are much the same as symptoms of collapse in the infectious diseases.

"A strong and healthy young man," writes Fischer, "was struck in the abdomen by the pole of a carriage drawn by runaway horses. No recognizable injury was done to any of the internal organs. Nevertheless, grave symptoms made their appearance immediately after the accident. The injured man was lying perfectly quiet, and paid no attention to anything going on around him. His face was drawn and peculiarly elongated, the forehead wrinkled, and the nostrils dilated. His weary, lustreless eyes were deeply sunken in their sockets, half covered by the drooping eyelids and surrounded by broad rings. The eyes had a glassy and vacant expression. The skin and the visible mucous membranes had a marble-like pallor. Large drops of sweat hung on forehead and eyebrows. The rectal temperature was subnormal. The sensibility of the whole body was greatly reduced; the patient reacted slightly, and only to very painful impressions. No spontaneous movements of any sort were made by the patient. On repeated and urgent requests he showed that he could execute limited, brief movements with his extremities. When the limbs were lifted passively and then let go, they fell down like lead. The sphincters were intact. The urine obtained by catheter was scanty and concentrated, but otherwise normal. The almost imperceptible pulse was rapid, irregular, and unequal. The arteries were narrow and of very low tension. The patient answered slowly, reluctantly, and only after repeated urgent questioning. His voice was hoarse and weak, but well articulated. On being repeatedly questioned, the patient complained of cold, faintness, and deadness of all parts of the body. When he shut his eyes he felt nauseated and dizzy. The respirations appeared irregular; long, abnormally deep, sighing inspirations interchanged with rapid and superficial ones, which were scarcely visible or audible."

The earliest theory of shock, following the work of Romberg and Pässler detailed in the preceding section, and the work of Crile, was that shock was a paralysis of the vasomotor center. But various observers—Porter, Seelig, Mann, Henderson, Morrison, Hooker, and others—showed that the vasomotor center is not paralyzed, but as a matter of fact, in shock, there is an extreme constriction of all the arterioles, giving the blanched, bloodless appearance to the skin. Porter showed that pressor and depressor reflexes of a rabbit in shock are entirely normal. Seelig and Joseph cut the vasomotor nerve going to one ear of a rabbit, causing all the vessels of the ear to be dilated.

Shock was then produced and the blood pressure raised by applying a clamp to the abdominal aorta. The increased blood pressure caused the vessels of the denervated ear to become intensely engorged, but the vessels of the normal ear remained small and constricted. Morrison and Hooker showed that the outflow of blood from perfused organs of animals in shock is less than from organs of a normal animal.

What becomes of this "lost blood" in shock? That seems to be the central problem of the condition at present, the general answer being that it accumulates in the veins of the splanchnic area, and does not go into the right heart. Cannon has advanced a theory that the vessels of the liver contract in shock and dam back the blood into the portal vein, etc., but this hardly bears critical analysis. Crile's theory of nervous exhaustion, demonstrated by the appearance of the cerebral cells has met no acceptance nor has the "acapnia" theory of Henderson. There is a general agreement however that in shock there is a diminution in the total amount of blood circulating. Mann showed that the amount of blood that can be obtained by bleeding and emptying the heart of normal animals is 76 per cent of the total amount of blood in the body, leaving 24 per cent in the tissues. When the animal is shocked, however, the amount to be obtained by bleeding and emptying the heart is only 61 per cent, leaving 39 per cent in the tissues, or in a man weighing 150 pounds, the amount thus lost is 525 c.c. Thus shock has been called by some writers "exemia."

We must accept this inconclusive state of the matter in planning methods of treatment of shock. The best results seem to come from attacking the low blood pressure. Epinephrine used intravenously is perhaps the best drug. Glucose (20 to 40 per cent) solution and normal salt solution used intravenously have saved some lives. The use of abdominal pressure is advocated. Cannon advocates the intraperitoneal injecting of salt solution and pituitrin. The Medical Research Committee, during the great war, seemed to have the best results with the intravenous injection of hypertonic Ringer's solution. The solution they used contained sodium chloride 2 gm., potassium chloride 0.05 gm., calcium chloride 0.05 gm., water 100 c.c. They also used a colloidal solution with gum acacia, the hope being that such a solution would stay in the vessels longer. The formula used was: calcium chloride (BP.) 0.075 gm., sodium chloride 1.325 gm., gum acacia 2 gm., water 100 c.c. It was given intravenously at the rate of 5 ounces in five minutes, at the temperature of 125° F. in the reservoir. The infusion was repeated in twelve to twenty-four hours if necessary.

Later work tends to show, however, that the use of such colloidal solutions is distinctly dangerous. It apparently agglutinates red corpuscles *in vivo* and delays clotting time of blood. Henderson and Haggard

point out that after hemorrhage, acacia solutions preserve plasma and that the important thing to replace is the corpuscles.

A differentiation should be made of the circulatory failure due to hemorrhage, from that of other forms of shock. Here blood transfusion is of the greatest benefit. In cases of air hunger due to hemorrhage or shock, Cannon found an intravenous injection of sodium bicarbonate to be beneficial, when transfusion was not available.

**C. Cardiac Failure Due to Valvular Disease.**—This form of decompensation is the one usually thought of by medical men when cardiac failure is mentioned. The effect of a serious valvular defect upon the heart muscle is always to increase its work, hence to cause hypertrophy and eventually to wear it out so that it becomes easily subject to attacks of fibrillation and flutter, or loses tone, or the property of contractibility so that pulsus alternans develops. Many years, however, may elapse between the occurrence of the valvular defect and the onset of the cardiac failure—during which time the heart may fully compensate for its anatomical crippling and do well under ordinary conditions of activity. Only when extraordinary exertion is required may it become evident that the reserve force of the heart muscle is impaired. As time goes on the narrowness of this reserve capacity may gradually be made more evident until finally almost none is left and even the slightest extra activity or prolonged ordinary activity may bring about signs of heart failure such as hyperpnea, rapid pulse, and edema of the ankles. In this stage treatment of a preventive nature should certainly be established. Later a severe grade of decompensation arrives. With the onset of auricular fibrillation it may begin suddenly with dyspnea, irregular pulse, enlargement of the liver, ascites, edema, pulmonary edema, manifested by râles heard at the bases of the lungs, and, in extreme grades, cyanosis. Here, of course, rest, digitalis, a dry diet, appropriate measures for symptomatic relief must be instituted.

Of the individual valvular diseases, mitral regurgitation is the most harmless: indeed an individual with a mitral regurgitation and moderate hypertrophy (which indicates a small leak) may live to an advanced age with ordinary and occasionally extreme activity (going through surgical operations, pregnancy, and labor) and never know a day's discomfort from the heart. Mitral stenosis, on the contrary, is seldom compatible with long life. The right ventricle bears a heavy burden in this disease, and the enlargement of the heart to the right—whether from dilatation or hypertrophy, I am not prepared to say—as seen with the fluoroscope is the precursor of death. Few patients with mitral stenosis live beyond the age of fifty. The prognosis of aortic regurgitation depends somewhat upon the etiology. If rheumatic, it is not incompatible with long life, but if syphilitic, particularly if there is involve-

ment of the aorta, it constitutes a very grave condition. Of the other valvular diseases, all are of most serious import though all are rare.

*Prevention of Cardiac Failure in Valvular Disease.*—In children valvular disease must always be accorded a very guarded prognosis. Aortic regurgitation or mitral stenosis initiated before the period of puberty usually results in cardiac failure and death during the time of growth. These children are usually prevented by medical advice from indulging in vigorous activities. It is a question whether this is wise or whether it actually prevents the onset of heart failure. "Strain" should be distinguished from "exercise." Going up-stairs, running, competitive races, rowing races, and football are all forms of strain. The removal of foci of infection is of more importance than any other thing.

Much the same advice may be given the adult with valvular disease. Exercise of a moderate sort is, I believe, good rather than bad. But "strain" of the heart should carefully be avoided. The removal of infective foci is necessary. The prevention of syphilis should really be the object of their particular attention. "Syphilis engrafted on a cardio-vascular system already injured by rheumatic fever is ruinous." (Barach.)

**D. Cardiac Failure in Arteriosclerosis and Hypertension.**—Patients with hypertension may have predominating heart failure or predominating kidney failure, or predominating vascular failure (as in cerebral apoplexy, or angina pectoris). The heart failure, in my experience, is the one usually overlooked. I shall not soon forget a discouraged gentleman with hypertension whom I saw some years ago, shortly after he had visited a famous clinic. His blood and urine had been thoroughly analyzed and he had reports showing just what he could and could not excrete. His treatment consisted in a careful supervision of his diet, and advice to have sweat baths weekly. Upon this he was getting weaker and weaker. An examination revealed some edema of the ankles, considerable dyspnea on exertion, a few râles at the base of the lungs and a general loss of tone of the sounds of the heart. Ten days' rest in bed on good sized doses of digitalis with a fuller diet and discontinuance of the baths which were weakening him restored his well-being marvelously and caused an amelioration of many of his symptoms.

Auricular fibrillation may occur in the course of hypertension, but usually the cardiac failure is a gradual loss of tone of the muscle, not accompanied by much irregularity. Digitalis is the best treatment. The hypertension, as has been seen in the section on digitalis, is no contraindication to the use of any member of the digitalis group.

In uncomplicated arteriosclerosis, mild exercise is an excellent heart tonic and preventive of cardiac failure. Walking, or better golfing, is the best form of exercise for the arteriosclerotic. Golf is preferable because it gives the patient something to think about. He becomes immersed in the contest, if not with his opponent, at any rate with the uncontrollable forces of Nature as exemplified by the ball, the club and the hole. It is certainly a good token for American civilization that in the past decade golf links have sprung up all over the country, not only in large cities but in villages and hamlets.

The most serious forms of myocardial degeneration occur in individuals past middle age and usually consist in localized sclerosis of the myocardium. One of the most important results of the recent work on the heart is the knowledge of the part these localized spots of myocardial degeneration play in the production of grave usually terminal forms of cardiac failure. The negativity of the T-wave in the electrocardiogram, and evidences of branch bundle block show this. A patch of degeneration may be so placed in the myocardium as to be perfectly innocent. A patch of degeneration the same size in the path of the excitation wave of the heart may do a great deal of damage.

**E. Cardiac Failure in Obesity.**—Actuarial statistics show that the mortality among overweights is high. In another section of this chapter we have shown how frequently hypertension is accompanied by overweight.

The form of cardiac failure in obesity is usually the gradual loss of tone. The important part of the treatment is preventive—by exercise and diet—the general treatment of obesity.

**F. Cardiac Failure Due to Endocrine Disease.**—1. *Hyperthyroidism.*—The tachycardia and hypertension of Graves' disease are admittedly difficult to treat. They can be explained by saying that the thyroid toxin increases the property of irritability of the myocardium. As digitalis and strophanthus also increase irritability, their employment is not only useless, but positively contraindicated. Quinine hydrobromate has been used more successfully. The recent introduction of quinidine (q.v.) as a heart depressant may explain this action, previously observed, of a quinine derivative. Quinidine sulphate itself has seemed to be in a few cases of more benefit than quinine hydrobromate in slowing the pulse of Graves' disease.

Goodpasture has followed two cases of exophthalmic goiter to autopsy and has shown that a marked necrosis of the myocardium occurred. In both these cases auricular fibrillation was present as a terminal event. Under usual circumstances auricular fibrillation is not present in hyperthyroidism.

The causes of the rapid pulse are very obscure; the most satisfactory explanation is that it is due to the action of a toxic substance on the

nervous control of the heart. Later, as Goodpasture has shown, actual myocardial change may occur.

2. *Other Endocrine Diseases.*—The menopause is a good example of the effect of the endocrine system upon the cardiovascular or at least vasomotor system. Not only are the heat flushings and the feeling of redness in the face and hands, a manifestation of vasomotor instability, but the onset of hypertension frequently follows closely on the termination of the epoch.

In other forms of endocrine dyscrasia cardiac upsets may occur, and cases of this kind, presenting cardiac symptoms as the prominent feature of the case, are far from rare. Often they are associated with high blood pressure, and studies of the endocrine hypertension in thyroid, pituitary and ovarian disease have been made by Englebach, Hopkins and Reisman. Relief of symptoms frequently attends the recognition of the proper cause.

**G. Cardiac Failure Due to Focal Infection.**—1. *Tonsils and Teeth.*—In Barach's study of the etiology of cardiac affections, tonsillitis was present in the history of a little less than one-third of the cases of valvular type, and about one-quarter of the cases of the myocardial type. This means that the organisms present in tonsillar crypts can either cause an endocarditis, or cause or aggravate a myocarditis, coronary thrombosis or aortitis. Focal infection, from the teeth, can do the same thing. Nothing has resulted in more gain to the individual, with the degenerative cardio-renal-vascular diseases of the latter decades, than the habit modern clinicians have acquired of searching for and removing these infections.

2. *Cholecystitis.*—Babcock, so far as I know, was the first clinician to point out the deleterious effect of gall bladder disease upon the myocardium. Not only has this frequently been proved out in my experience, but I have often seen cases of gall bladder disease come to the clinic or to the consulting room complaining only of palpitation, dyspnea and other symptoms of cardiac pathology, when it will be discovered that a long and suspicious history pointing to the gall bladder is present and that apparently an acute exacerbation initiated the cardiac attack.

So strongly do I believe that this aspect towards cholecystitis is a correct one, that I feel justified in urging patients to have an operation for gall bladder disease performed, on the grounds that the continued presence of a cholecystitis or cholelithiasis is a menace to the integrity of the heart. Not once but several times I have seen in patients over sixty a gallstone attack with lodgment of a stone in the cystic duct initiate an auricular fibrillation which resulted fatally.

**H. Cardiac Failure Due to Adhesive Pericarditis.**—This is a rare form of cardiac failure but Ellsworth Smith who recently reported two cases, states that is is more common than is usually recognized. When there are strong adhesions between the visceral and parietal layers of the pericardium, these may mechanically so interfere with the systole of the heart, as to cause great inefficiency. In one of Ellsworth Smith's cases digitalis was exhibited with little success before operation but after operation when the mechanical difficulty had been relieved, the heart responded well to the drug and the signs of cardiac failure, such as the ascites were promptly relieved. Allbutt says: "Operation seems indicated if there be a strong retraction of the ribs, and distressful heart or dropsy and dyspnea not relieved by ordinary means." The operation, which is always done under local anesthesia, is cardiolysis—the resection of the ribs of the anterior chest wall over the heart, so that when the heart contracts it will not tug upon an immovable wall. Smith's article contains a good bibliography.

**I. The Heart in Pregnancy and Labor.**—The internist is not infrequently consulted by a woman who wishes to know whether her heart is able to undergo the strain of a pregnancy and labor. There is an old tradition that the heart enlarges during pregnancy; and a general belief that labor puts a most severe test upon the myocardium. The question has been the subject of two very careful sets of observations from somewhat different viewpoints.

Smith has made electrocardiographic studies of women during pregnancy and in labor. He concludes that pregnancy in itself does not cause cardiac enlargement. The pressure of the gravid uterus may displace the heart somewhat and cause an apparent enlargement. While both pregnancy and labor throw some load on the heart, it is not more than can easily be compensated for, even by a heart which has valvular disease. Irregularities of the pulse during labor were so infrequent and so trivial in Smith's experience as to be negligible; sinoauricular block he found frequently. He even records one woman with a permanent auricular fibrillation who passed through a sixth pregnancy "none the worse."

Pardee investigated the question from a slightly different angle. He took 39 women who had valvular disease and were pregnant and followed them through to delivery. He applied an exercise test to them consisting of raising a ten-pound dumb-bell over the head 20 times—observing the dyspnea, pulse rate and other distress. Those patients who were not troubled with dyspnea at any time before or during pregnancy, mostly mitral cases, stood labor well. In the patients who had some dyspnea on exertion before pregnancy with an aggravation of it during

pregnancy there were four deaths among 18 patients, and 4 others had pulmonary edema during labor. Of the 4 who died, 2 had mitral stenosis, 1 had aortic regurgitation, and 1 had aortic regurgitation and double mitral disease.

In general then we may advise patients who have simple valvular disease with no evidences of decompensation that they may pass a pregnancy with no more danger than any other woman, but that the history of a period of decompensation considerably increases the risk.

## IV. Summary of General Methods of Treatment of Cardiac Failure

General methods of treatment of cardiac failure may be said to be rest, drugs, hydrotherapy, exercise (including massage), diet, psychotherapy, the removal of focal infection and such miscellaneous procedures as the rare use of mechanical pressure on the vagus or eyeball, and the rarer use of surgical interference or paracentesis. They have all been considered in detail either in the first section or in this chapter, and it remains only to give a brief review of them and to pick up the tag ends.

**A. Rest.**—No treatment of cardiac failure is likely to be successful which does not have rest as an essential part.

**B. Drugs.**—*Digitalis* is indicated in the congestive form of heart failure with irregular pulse (auricular fibrillation), dyspnea, edema, and pulmonary and hepatic congestion found particularly in mitral stenosis, atherosclerotic myocardium and as a late event in hypertension. *Strophanthanin*, the action of which is similar to digitalis, should be chosen whenever rapid digitalis action is required. It can be given intravenously.

*Quinidine sulphate* by reducing irritability of the heart muscle is useful in the irregularities: auricular fibrillation, extrasystoles, and paroxysmal tachycardia.

*Atropine, thyroid extract, adrenalin, potassium iodide* and *barium chloride* may be used in heart block.

*Atropine* is used in nodal rhythm.

*Morphine* should be used in most severe forms of cardiac failure for its general sedative effect.

*Euphylline, theophylline* and *theobromine sodium salicylate* are valuable in heart failure associated with arterial and renal disease, anginal attacks and where improved coronary circulation is the key to relief—in short, in the arteriosclerotic form of heart failure.

*Magnesium sulphate* is used to relieve dropsy by promoting watery evacuations.

*Novasurol* and *ammonium chloride* are valuable in the edema of cardio-

renal or tonal heart failure with regular pulse. If digitalis has failed, they are the drugs of choice.

**C. Hydrotherapy.**—Particularly applicable to the heart failure of the infectious diseases—typhoid, pneumonia, etc. The wet pack, and the Brand bath are the methods used.

The Nauheim bath is used in loss of myocardial tone.

**D. Exercise and Massage.**—It is usually considered that exercise is to be avoided in patients with valvular disease, or loss of cardiac tone, as the strain is likely to bring on decompensation. Consequently, exercise is usually forbidden in actual cardiac failure. Barringer, however, is inclined to question these ideas. Reviewing 154 cases of heart failure complicating chronic valvular or muscle disease he found that only in 3 instances was there a history of physical strain at the onset of symptoms. He uses mild exercise in all his heart patients who can stand it.

It is to be remembered that the resistance exercises of the brothers Schott were especially adapted to the patients with moderate loss of tone, myocarditis, and fatty heart.

**E. Diet.**—In fully compensated heart disease diet is of no importance.

In cases of failure with dropsy, ascites and so forth a restriction of fluid is indicated. The reason is obvious—to reduce the load of fluid which the heart must pump around.

For similar reasons salt is restricted. In nephritis with edema the salt-free diet is given because the kidney does not excrete salt well and its accumulation in some degree helps to cause the edema. In cardiac failure the kidney may or may not be permeable to salt and the salt-free diet may or may not be helpful.

The Karrell diet which is often prescribed consists of the feeding of 200 c.c. of milk every four hours for five days and gradually adding eggs, chopped meat, and so forth.

The Smith, Gibson and Ross diet (see Chapter on Dietetics, p. 290) furnishes 2100 calories, largely in the form of carbohydrates.

**F. Psychotherapy.**—A most important feature of treatment in these cases is encouragement to the patient. Direct explanation of his condition and the hopefulness of it is the physician's duty and privilege. Talk of "heart disease" and technical discussions before the patient are often little less than terrifying, and unnecessarily so.

Even more important is the handling of patients in whom a heart murmur of which the patient is unaware is found in the course of a routine or casual examination. In most cases it is usually entirely unnecessary to say anything about it. Every physician particularly inter

ested in the heart knows of person after person who has been made miserable and, even in some instances, invalided on account of the triumphant assertion of the physician delegated to examine applicants for gymnasium work, that a heart murmur was present. The examiner for life insurance cannot always hold his counsel so easily, but here too tact can be used.

**G. Removal of Focal Infection in the Teeth, Gall Bladder, Seminal Vesicles, Prostate or Tonsils** is indicated particularly in the cardiac failure of arteriosclerosis, and angina.

**H. Miscellaneous Procedures.**—1. *Pressure on the carotids and eyeballs.* In cases of paroxysmal tachycardia attempts should be made to stimulate the vagus by drinking cold water, inducing vomiting, taking a long breath and holding it, lowering the head, or finally and most effective, pressure over the carotids or eyeballs.

2. *Surgical Procedures.*—Cardiolysis, as mentioned above in the chapter on adherent pericardium, may be indicated. So may paracentesis abdominis or thoracentesis for accumulation of fluid. (Both described in Part I.) Scarification and bandaging the legs for edema is described above.

## References

### *Pericardium*

Billings: Discussion before the Association of American Physicians, 1922. Quoted in Jour. Am. Med. Assn., July 1, 1922, lxxix, No. 1.

Lauder Brunton: Lectures on the Action of Medicine.

Williamson: Pericarditis with Effusion, Arch. Int. Med., February, 1920, xxv.

### *Angina Pectoris*

Allbutt, Sir Clifford: Diseases of the Arteries, including Angina Pectoris, MacMillan, 1915.

Heberden: Treatise on Medicine, London, 1812.

Herrick: Thrombosis of the Coronary Arteries, Jour. Am. Med. Assn., Feb. 8, 1919, lxxii, No. 6.

Herrick and Nazum: Angina Pectoris, Jour. Am. Med. Assn., Jan. 12, 1918, lxx, No. 2.

Ingals and Meeker: Angina Pectoris, Jour. Am. Med. Assn., April 6, 1918.

Willius: Angina Pectoris. An electrocardiographic study. Arch. Int. Med., 1921.

### *Arteriosclerosis, Hypertension, etc.*

Allbutt: Diseases of the Arteries including Angina Pectoris, 1915, 2 volumes.

Allen, Frederick M.: Arterial Hypertension, Jour. Am. Med. Assn., March 6, 1920, lxxiv, No. 10.

Englebach: Arterial Hypertension Associated with Endocrine Dyscrasia, Jour. Am. Med. Assn., June 12, 1920, lxxiv, No. 24.

Gager: Sulphocyanate Therapy in Hypertension, Jour. Am. Med. Assn., Jan. 14, 1928, xc, 82.

Janeway: A Study of the Causes of Death in 100 Patients with High Blood Pressure, Jour. Am. Med. Assn., Dec. 11, 1912, lix, No. 24.

Janeway: Clinical Study of Blood Pressure, D. Appleton Co., 1904.

Krehl: Ueber die Krankhafte Erhohung des Arteriellen Druckes, Deutsch. Arch., f. klin. Med., 1905, xxi, 1872.

Miller, J. L.: Hypertension and the Value of the Various Methods for Its Reduction, Jour. Am. Med. Assn., May 21, 1910, liv, 1666.

Musser, John H.: Treatment of Arterial Hypertension, New York Med. Jour., Oct. 16, 1920.

Pall: Gefasskrisen, Leipsic, 1905.

Williams: The Total Non-Protein Constituents of the Blood in Arterial Hypertension, Arch. Int. Med., xxvii, No. 6.

### *Aneurysm and Aortitis*

Hare: Articles on Wiring and Electrolysis of Sacculated Aneurysms. (1) Therap. Gaz., Jan. 15, 1900, xxiv, 9. (2) Jour. Am. Med. Assn., April 13, 1912, lviii, 1088. (3) Jour. Am. Med. Assn., April 18, 1914, lxii, 1217. (4) Ibid., Dec. 20, 1919, lxxiii, 1865.

Hubert: München, med. Wchnschr., Dec. 12, 1919, lxvi, No. 50.

MacLachlan: The Medical Treatment of Aortic Aneurysm, Am. Jour. Med. Sc., clix, No. 4.

Wile: Treatment of the Syphilitic Liver and Heart, Am. Jour. Med. Sc., September, 1922, clxiv, No. 3.

### *Treatment of Cardiac Failure*

Babcock: Chronic Cholecystitis Complicating Cardiac Lesions, Jour. Am. Med. Assn., Dec. 27, 1919, lxxiii, No. 26.

Barach: Etiology of the Cardiovascular Affections, Jour. Am. Med. Assn., April 30, 1921, lxxvi, No. 18.

Barringer: Principles Underlying the Treatment of Heart by Exercise, Jour. Am. Med. Assn., July 2, 1921, lxxvii, No. 1.

Bishop, L. F.: Specific Action of Atropine in Relieving Certain Irregularities of Heart Beat. Jour. Am. Med. Assn., July 2, 1921, lxxvii, No. 1.
Boothby: Am. Jour. Physiol., 1915, xxxvii, 383.
Brooks and Carroll: The Management of the Heart in Pneumonia, Am. Jour. Med. Sc., December, 1920, clx, No. 6.
Cannon, and others: Shock, Jour. Am. Med. Assn., Feb. 23 and March 2, 1918, lxx, No. 8 and 9.
Cohn, A. E.: The Present Status of the Electrocardiographic Method in Clinical Medicine, Am. Jour. Med. Sc., April, 1916, cli, No. 4, p. 529.
Cohn and Levine: Barium Chloride in Adams-Stokes Disease, Arch. Int. Med., July, 1925, xxxvi, 1.
Dieuaide and Davidson: Terminal Cardiac Arrythmias, Arch. Int. Med., November, 1921, xxviii, No. 5.
Englebach: Arterial Hypertension Associated with Endocrine Dyscrasia, Jour. Am. Med. Assn., June 12, 1920, lxxiv, No. 24.
Fahr: The Heart Muscle in Goiter, Centralbl. f. allg. Path. u. Path. Anat., 1916, xxvii, No. 1.
Goodpasture: Myocardial Necrosis in Hyperthyroidism, Jour. Am. Med. Assn., June 4, 1921, lxxvi, No. 23.
Henderson, Yandell: Bull. Johns Hopkins Hosp., August, 1910, xxi, No. 233.
Heineke: Experimentelle Untersuchungen über die Todesursache bei Perforations Peritonitis, Deutsch. Arch. f. klin. Med., 1901, lxix, 429.
Lewis: Clinical Disorders of the Heart Beat, P. B. Hoeber, New York, 1912.
Levine: Acute Cardiac Upsets, Occurring During or Following Surgical Operations, Jour. Am. Med. Assn., Sept. 18, 1920, lxxv, No. 12.
Mann: Shock and Hemorrhage, Surg., Gynec. and Obst., 1915, xxi, 430.
Marvin and White: Observations on Paroxysms of Tachycardia, Arch. Int. Med., April, 1922, cxxix, No. 4.
Meltzer: Oedema, Am. Medicine, 1904, viii, 19, 59, 151, 191.
Musser: Theophylline-Ethylenediamine in Heart Disease Associated With Pain, Jour. Am. Med. Assn., Oct. 27, 1928, xci, 1242.
Newburgh and Porter: Jour. Exper. Med., 1915, 22.
Peabody: Cardiac Dyspnea, Harvey Lecture, 1917.
Pearce: Cardiorespiratory Mechanism in Health and Disease, Arch. Int. Med., February, 1921, xxvii, No. 2.
Porter, W. T.: Am. Jour. Physiol., 1907, xx, 399.
Robey and Boas: Neurocirculatory Asthenia, Jour. Am. Med. Assn., Aug. 17, 1918, lxxi, No. 7.
Romberg and Passler: Experimentell Untersuchungen über die Allgemeine Pathologie und Therapie der Krieslaufsstorungen bei acuten Infectionskrankheiten, Deutsch. Arch. f. klin. Med., 1899, lxiv, p. 652.
Seelig and Joseph: Jour. Lab. and Clin. Med., 1916, i, 283.
Smith: Cardialysis for Chronic Mediastino Pericarditis Med. Clinics, North America, November, 1920, iv, No. 3.
Smith: Observations on the Heart in Diphtheria, Jour. Am. Med. Assn., Sept. 3, 1921, lxxvii, No. 10.
Smith, Fred M.: Clinical Observations on Paroxysmal Auricular Fibrillations and Flutter, Am. Jour. Med. Sc., July, 1921, clxii.
Smith, S. Calvin: The Heart Irregularity Called "Sinoauricular Block." Am. Jour. Med. Sc., 1921.
Welch: Pulmonary Oedema—Virchow's Archiv, 1878, lxxii, 375.
White: Acute Heart Block, Am. Jour. Med. Sc., 1916, clii, 589.
White: Alternation of the Pulse. Am. Jour. Med. Sc., July, 1915, cl, No. 1, p. 82.
White, Paul D.: The Heart in Infectious Diseases, Am. Jour. Med. Sc., March, 1922, clxi, No. 3.

## CHAPTER XIX

## DISEASES OF THE RESPIRATORY SYSTEM

### I. ACUTE AND CHRONIC TONSILLITIS

**Treatment of Acute Tonsillitis.**—1. Rest in bed during the period of fever.

2. Care of the teeth, tongue, bowels, skin, eyes and nose, as for an acute infection as described in the chapter on infectious diseases.

3. Local treatment by gargles and application of silver nitrate (5 to 10 per cent).

4. Drugs: The salicylates and coal tar products. The following prescription is a standard:

℞

| | |
|---|---|
| Acid acetyl salicylic | |
| Acetphenetidin | āā gr. xxiv |
| Caffeine citrate | gr. xii |

M. and ft. caps. No. 12.

Sig: One every two to four hours.

5. Complications: A. Retropharyngeal abscess. Quinsy. The abscess should be opened by the method of Mierhof, a finger introduced into the mouth (gag used if necessary) to locate the point of greatest fluctuation and a closed hemostat introduced and guided by the finger, plunged into the abscess, the blades opened and withdrawn. The patient should be in the upright position.

B. Otitis media—common in children from associated adenoid infection. Treatment by paracentesis of the ear drum and drainage.

#### Chronic Tonsillitis

Infection of the tonsils with various organisms from streptococci to tubercle bacilli (2.35 per cent) may cause any of the following diseases: Myositis, tenosynovitis, arthritis, acute infectious arthritis, neuralgia, lumbago, cervical adenitis, tubercular cervical adenitis, pulmonary tuberculosis (?), toxic goiter (?), endocarditis, myocarditis, nephritis, headache, vertigo, gastric ulcer (?), various forms of skin disease, iritis, retinitis, etc.

It would seem a reasonable procedure under the circumstances, when infection is found in tonsils, to remove them.

## II. DISEASES OF THE BRONCHI

### 1. Acute Rhinotracheobronchitis

**Treatment.**—1. Rest in bed for temperature.

2. Hot lemonade at night, mustard foot bath.

3. Drugs: *Early Stage*—coal tar products; aspirin, phenacetin and caffeine as in prescription suggested above for acute tonsillitis.

*Later stage*—cough lozenges or cough mixture to soothe larynx such as:

℞

| | |
|---|---|
| Menthol | gr. i |
| Codeine phosphate (if desired) | gr. vi |
| Amm. chloride | ʒ i |
| Syr. Pini Virg. | ℥ iv |

M. and ft. sol.

Sig: Teaspoonful as needed.

Fig. 79.—Means' method of inhaling steam or aromatic substances for local effect on the bronchi. A pitcher of boiling water with the inhalant added, a glass tube through which the patient inhales, and a towel over the top of the pitcher protects the patient's skin around the nose and mouth from irritation. (Redrawn after Means.)

### 2. Bronchiectasis—or Chronic Bronchitis

There are two types:

1. The dilatation of a single bronchus, secondary to inhalation of a foreign body or a lung abscess, occasionally following influenza or pneumonia. This type is rare, occurs at any age (may be in young people contrary to the rule in the second class) and may become an actual pleural vomica.

*Treatment* is by removal of the cause, in the case of the foreign body, drainage surgically if feasible or severe enough, or palliative measures

of rest, climate and iodide of potash. Spontaneous recovery is not impossible.

2. Generalized bronchiectasis, with dilatation and injection of many terminal bronchi is a common disease, occurring usually in people past middle age, and often in association with emphysema.

Not enough attention is given by the profession to the prevention and

Fig. 80-*A*.—Lung showing abscess in base due to spirochetal infection.

treatment of this condition. We are accustomed to speak of the "natural causes of death," meaning death by the degeneration of the body in the process of time; and as physicians we think largely of the cardiac, the vascular, and the renal routes of exitus. There is besides a respiratory route. The initiation of the gradually advancing process is usually an infection of the nasal sinuses. It may be a severe bron-

chitis, amounting to a bronchopneumonia, or it may be a simultaneous nasal and bronchial infection. From the nose the infection invades the bronchi. There is much coughing, which in an elderly person causes

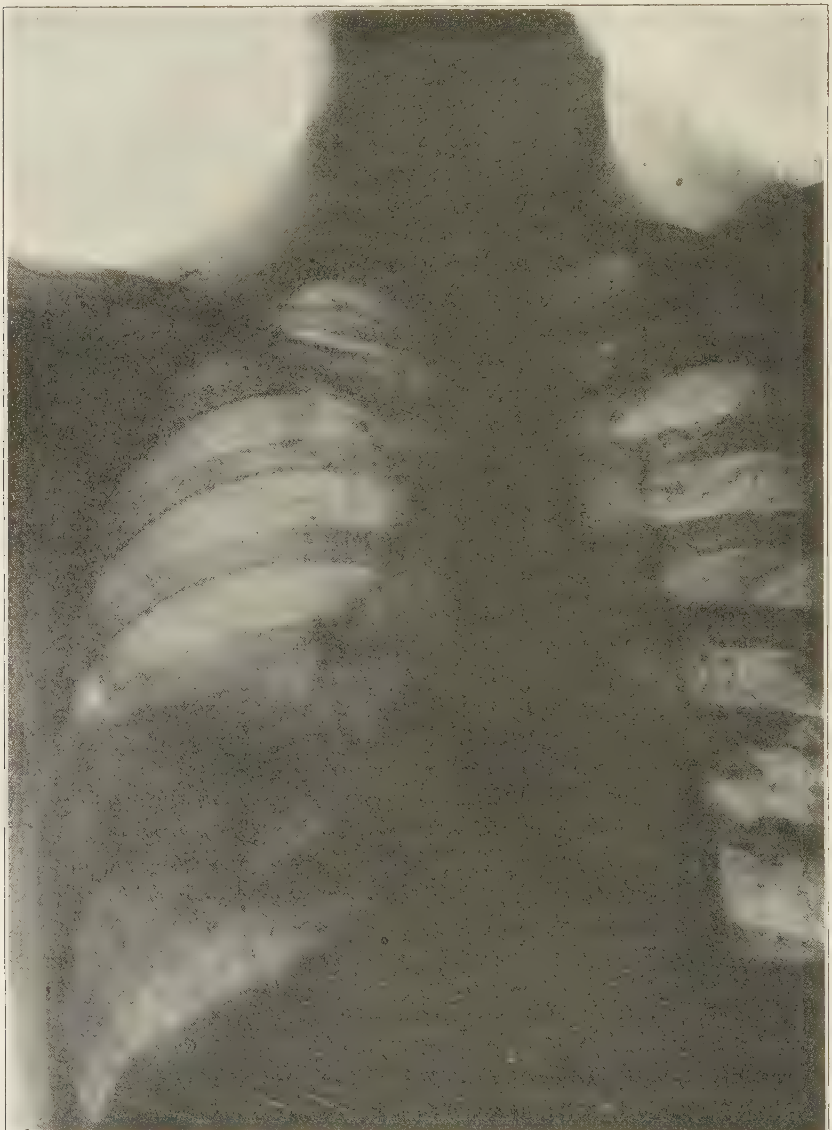


Fig. 80-*B*.—Radiograph of patient with pulmonary abscess in right base due to spirochetal infection.

some giving away of the bronchial walls; the infection invades the actual walls of the bronchi and adjacent alveoli, which further weakens these bronchial walls and allows of further dilatation. From the focus

come further waves of infection, keeping up the advance of all the processes. The patient now has constant bronchial pus and secretion; and coughing, in the morning especially, is a long-drawn-out affair, causing great strain on the bronchial and alveolar walls. Emphysema and bronchiectasis result, clubbed fingers and hypertrophic osteoarthropathy follow and cardiac failure supervenes. In the terminal stages little can be done for the patient, except to move him to a dryer climate, and aid drainage by inhalations of menthol, benzoin, etc. Surgery has been used in some cases where the accumulation of pus is large enough to justify it.

Fig. 81.—Patient with lung abscess due to spirochetes and fusiform bacilli. View of patient's mouth to show gingivitis and infection with Vincent's organisms which were probably the cause of the lung abscess.

In the early stages, before structural change in the bronchi has occurred, much may be done by clearing up the focus of infection in the nose. This is the most important thing in treatment. Vaccines, removal to warm dry climate and inhalations should all be instituted.

Postural drainage is a method of treatment never to be neglected in these patients. It consists in having the patient assume an upside down position, so that the pus from the dilated bronchi can run out of the mouth. The easiest way to perform it is to have the patient hang over the side of the bed with the head on the floor. Astonishing im-

provement occurs at times, even apparent cures. In bronchiectasis the procedure should be rigorously carried out every morning and evening for months and even years. Mandelbaum has constructed an apparatus consisting of a sort of athletic turning bar which is manufactured by G. P. Pilling & Son, Philadelphia, for effective postural drainage of bronchiectasis and lung abscess.

### 3. Spirochetal Bronchopulmonary Infection

In a large numer of nontuberculous pulmonary infections the infective agent is a spirochete often in association with a fusiform bacillus. Competent pathologists, such as Franchini, are of the opinion that these organisms are identical with the similar organisms described by Vincent which are almost invariably to be found in the mouth and nose, and occasionally cause an acute gingivitis ("Trench-mouth"). Kline and Blankenhorn, and later Kline and Berger, have reported a number of these cases in this country. Pilot and Davis give a comprehensive report. The clinical pulmonary conditions for which the organisms are responsible range from recurring bronchitis, chronic bronchitis and bronchiectasis to lung abscess and pulmonary gangrene.

Recognition of the condition is very important for the therapist because so much can be done for these patients with neoarsphenamine. The drug is toxic to the Spirocheta buccalis as well as to the Spirocheta pallida. Such cases are often mistaken for tuberculosis, although the sputum remains negative for tubercle bacilli. To demonstrate the spirochetal organism in the sputum, gentian violet stain or simple carbolfuchsin, omitting the decolorizing with acid-alcohol and counterstaining should be employed. The patients often have hemoptysis or hemorrhagic sputum. In the simpler cases the spirochete alone is found. When gangrene occurs, it is usually the sign that the fusiform bacillus has assumed the major rôle. In this latter event the neoarsphenamine cannot be expected to do as much good as in the earlier cases, and surgical drainage will have to be employed. I have several patients with a mild bronchiectasis—thin, easily-catching-cold types of invalids—who take an intravenous dose of neoarsphenamine once every three or four months. Lipiodol injections are also helpful.

**4. Bronchial Asthma.**—See chapter on Allergy.

## DISEASES OF THE LUNG

### 1. Congestion of the Lungs

The only congestion of the lungs (in spite of the active congestion of most textbooks) is the congestion consequent upon apparently preponderant right heart failure or on a combination of right heart dilatation and obstruction of the return of blood to the left heart. One of the most

fascinating books for the clinician is the recently published Gross's "Anatomy of the Heart." In this he shows by sodium bromide injections of the coronary circulation in a series of hearts at different decades, the advancing anemia of the right heart beginning at the fifth decade. This purely anatomic finding is borne out in clinical experience for instance by the high incidence of death in mitral stenosis during this decade. (In mitral stenosis the right heart does the preponderance of the work.) What is more to our purpose is the frequent occurrence of spells of sudden cardiac failure at this same age with prominent symptoms of cough, rusty sputum, crackling râles over the lung bases, and liver enlargement (that is right heart preponderance in the failure). The treatment is by rest, digitalis, purges, and Karell diet.

### 2. Pneumonoconiosis

Pneumonoconiosis is an industrial disease and when established admits of no treatment. The symptoms and disability are much the same as those of cirrhosis of the lung from other causes. Emphysema and bronchitis are the regular secondary familiars of the condition. Prevention is all-important, the use of masks in dusty occupations, the employment of the various devices for reducing the dusts in the air.

### 3. Emphysema

Several varieties of emphysema are usually distinguished. Dilatation of the pulmonary alveoli, as a compensatory phenomenon or as the result of bronchial obstruction, as in asthma, is not to be considered the object of direct treatment. The variety called the large-lunged emphysema, in which there is not only dilatation of the alveoli, but also rupture of contiguous alveolar walls, is a condition in which great disability occurs and in which therapy is largely helpless. Here, again, prevention is a great feature. There is need for propaganda concerning the prevention of the forms of the pulmonary route of senescence—in which bronchiectasis, pneumonoconiosis, asthma, right heart failure and emphysema occur in varying mixtures.

Emphysema occurs in people who have done hard manual labor, or are engaged in exposed occupations, (such as cab-drivers, motormen, etc.) and in dusty occupations. I have a series of cases in which the patients showed overweight and asthma (the cause of which could not be found). Their occupations were not always strenuous. Reduction of weight, clearing up foci of infections and rest were helpful in reducing dyspnea.

In established emphysema treatment should be directed as follows:

1. Rest is the most important element in treatment.

2. Breathing exercises, for the purpose of increasing the amount of air expelled from the lung. Increase in the strength of the muscles used in expiration, particularly the abdominal muscles, may be obtained by easily designed exercises. Mechanical devices to compress the chest have been invented, but the arms of a friend of the patient clasped about the chest are as good as any.

3. Treatment of the heart failure by usual methods.

4. Freund has suggested resection of the costal cartilages to relieve thoracic rigidity.

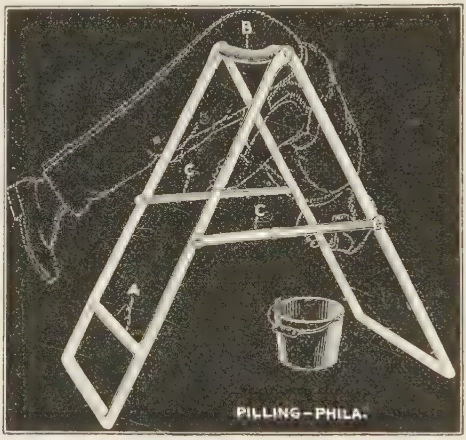



Fig. 82.—Mandelbaum's apparatus for postural drainage in lung abscess and bronchiectasis.

### 4. Pulmonary Abscess

The most frequent causes of abscess of the lung are:

1. Pneumonia.
2. As a sequela of tonsillectomy.
3. Inspiration of foreign body.
4. Infective emboli.
5. Trauma.
6. Inspiration of infectious material from the nose or teeth. (See above "Spirochetal Bronchopulmonary Disease.")

It must be sharply differentiated from localized empyema of the pleura (pleural vomica). Single bronchiectatic abscess is practically the same thing as lung abscess. Subphrenic abscess rupturing through the diaphragm may give the picture, and really becomes a lung abscess.

The treatment varies somewhat as to cause. The postpneumonia abscess may be very serious. The most urgent indication is the deodorization of the sputum. Creosote internally will sometimes help. Burning

a creosote inhalant in the room, filling the sputum cup with carbolic and fosmalin, and frequent mouth washes are also valuable. When the patient's condition will permit, aspiration and surgical drainage is indicated. Many smaller abscesses clear up spontaneously. Iodide of potash in large doses is, in the hallowed words of therapeutic literature, a sheet anchor.

The abscess due to foreign body must be treated by bronchoscopic removal of the foreign body.

The lung abscess following tonsillectomy is a product of civilization and is by all odds the most frequent form of lung abscess we see today. The patient is not nearly so sick as with the postpneumonic form, and the sputum is usually not foul. Prevention is important. I think there is no doubt in any investigator's mind that they are due to inhalation of septic material during the operation. The anesthetist is in a position of great trust in this matter. The abolition of the swallowing reflex puts the patient in danger. The patient's position, the depth of anesthesia, the use of the suction pump, must all be given careful consideration.

Once the abscess has occurred, the choice of treatment is a matter for good judgment. Surgery is the first thought, and yet after some considerable experience I am not prepared to advocate it. The abscess is diffuse in lung tissue, has not sharp walls, and surgical drainage is not likely to be complete. Surgery in my experience has usually left these cases worse off than it found them.

Artificial pneumothorax seems the best method. Tewksbury has had over 80 per cent good results with it. I have treated several cases thus with good results.

Postural drainage as practiced in cases of bronchiectasis and described above under that heading is of the greatest value. Lambert states that 50 per cent of patients with lung abscess were completely cured by this means alone.

Cure in the course of time may, however, usually be expected. Iodide of potash, time and open air are capable of giving permanent relief to most of these patients. Neoarsphenamine is valuable in abscess due to spirochetes and fusiform bacilli (see above "Spirochetal Broncho-pulmonary Disease").

### 5. Pulmonary Edema

Pulmonary edema was considered in the section on heart disease. Atropine, particularly in conjunction with morphine, usually is the immediate drug of choice.

## DISEASES OF THE PLEURA

### 1. Acute Fibrinoplastic Pleurisy

**Treatment.**—A. Strapping the chest is of primary importance and usually of itself gives complete relief. Altnow has suggested that complete immobilization of the chest is possible, by using adhesive tape not only around the chest from front to back, but also applying a band of adhesive going over the shoulder, at right angles to the first. He describes it as follows:

"A few years ago while reading C. F. Hoover's article in *Oxford Medicine* on 'The Respiratory Excursion of the Thorax,' I hit upon the simple and effective method here described. The physiologic principle involved is taken from the article mentioned: 'The mechanism for the ventilation of the anterior or upper lobes is provided for by the scaleni and the intercostal muscles. The scaleni anchor the first rib, and the

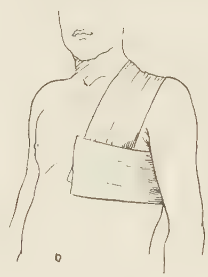


Fig. 83.—Altnow's method of strapping the chest in acute fibrinoplastic pleurisy.

intercostals, each in turn, elevate the rib below. This elevating movement occurs from the first to the fourth rib, inclusive, and provides for the ventilation of the upper lobes. In the ribs below, the inspiratory elevation is greatly accentuated by the lateral "bucket handle" movement of the ribs from the fifth to the tenth, inclusive. The latter movement, to a large extent, accomplishes the ventilation of the lower lobes.'

"From this description, it occurred to me that immobilization of the upper chest could be accomplished by preventing the upward movement of the first to fourth ribs, inclusive, by fixation of the bandage below the fourth rib anteriorly and posteriorly. The adhesive tape is started in front as low down as the sixth rib, and is brought up over the shoulder. As the patient holds the chest in full expiration, the posterior application of the strap is completed with as much downward pressure as possible. Two straps applied in this manner are sufficient. A horizontal strap helps in anchoring the ends of the two main straps.

"Clinical experience with several cases of upper lobe pleurisy, in

which this method of fixation of the chest was tried, has proved its effectiveness. The patient experienced almost immediate relief in each instance in which this method of treatment was employed.

"Therapeutic Application. The method is applicable in:

"1. Upper lobe and apical pleurisy occurring in the course of tuberculosis, pneumonia and those due to other infections, when relief from distress is necessary.

"2. Fracture of the four upper ribs or other injury of the upper thorax, when immobilization of the chest is desirable.

"3. Apical tuberculosis, to augment Nature's attempt at fixation of the affected apex."

B. Rest in bed.

C. Drugs: Aspirin, phenacetin and caffeine at first. If not effective, codeine or Dover's powder.

### 2. PLEURAL EFFUSION

In passing, experience has inclined me to believe that this common disease is less understood by practitioners generally than any other equally common disease. It seems to be practically never presented to medical classes, and seldom discussed with them. In consultation I find the diagnosis of empyema and pneumonia made in preference to pleural effusion when it is actually present. The points that appear especially to puzzle internes are that fluid can collect primarily in the pleura without heart disease, preceding pneumonia, or nephritis, and that with a high temperature the fluid removed is serous and not purulent. The tuberculous nature of the disease is a keynote in its management. *Treatment* consists in:

1. Aspiration or thoracentesis. The technic is described in Chapter XIV. There is some discussion as to the proper time for aspiration. In such discussion the words "early" and "late" are bandied about without definition. Let us try to localize the process in time. The effusion comes on suddenly with pain and fever. The acute febrile period lasted, in my series, from five to twenty-eight days—over 50 per cent lasting longer than ten days. The febrile period is self-limited, in the sense that it runs an acute course and stops. Aspiration seldom influenced the fever during this period. The effusion accumulates rapidly and may be very large. If aspiration is done as soon as fluid is made out, and while temperature is high, the effusion usually reaccumulates and aspiration is again necessary. If aspiration is deferred until the febrile period is definitely subsiding one thoracentesis is enough in two-fifths of the cases. My own preference is to allow this ripening process to

occur, and to aspirate at the termination of the febrile period, provided the effusion does not become too massive. I believe that when such advocates as Delafield advise early aspiration, this is what they mean. Delafield says that early aspiration hastens recovery, prevents the formation of adhesions, and pulmonary infection.

The amount of the fluid is the second point in the decision of when to aspirate (or to aspirate at all). Lord says that an effusion large enough to cause dislocation of the heart or which causes cyanosis, and a bilateral effusion should be tapped. In my opinion dislocation of the heart seldom occurs, and does no harm if it does. I aspirate much smaller amounts of fluid than Lord indicates.

The number of tappings on a single patient, in my series, ranged from one to nineteen. (In some no tapping was done.)

2. The postaspiration treatment is of momentous importance. Eighty-five per cent of the cases are caused by bacillus tuberculosis. The patients, after the fever has subsided and all fluid is removed, must submit to a tuberculosis regime for at least a year. Only those who have seen the sad results of neglect of this precaution realize its full importance.

3. Symptomatic treatment of cough, pain, restlessness and fever will be enjoined usually by the patient's importunities if the wise physician does not anticipate their necessity.

4. Autoserotherapy introduced by Gilbert consists in the removal of a few cubic centimeters of the fluid and immediately injecting it subcutaneously into the patient. He believed it promoted a rapid absorption of the effusion. Lyter has reported unfavorably on it, denying Gilbert's conclusions. I have tried it in a few recurrent stubborn effusions without result.

### 3. Empyema of the Pleura

Strictly empyema of the pleura is always a surgical condition. In some cases, however, medical treatment—aspiration, repeated aspiration, continuous aspiration, rest and the injection of gentian violet and other antiseptic or bactericidal substances—may cause resolution and prevent operation.

The cases which are favorable for such treatment are hard to define. When actual pus forms medical methods are usually ineffective. The same may be said of a large number of living bacteria in the fluid. In pneumococcic pneumonia operation is nearly always inevitable. In a few cases, however, aspiration once or twice may be followed by absorption of the fluid. In the loculated clear effusion of bronchopneumonia and streptococcic pneumonia success is even more likely.

**Gentian Violet Method.**—In certain cases Major has been able to sterilize the empyema cavity and cause resolution without the necessity of resorting to operation, by the injection of a solution of gentian violet. The solution used is an aqueous 1:5,000 dilution; at times higher strengths are used. The fluid in the cavity is first aspirated and then 100 c.c. of the solution of gentian violet introduced. About half of Major's cases were rendered sterile and operation prevented.

**Chronic Nonclosable Empyema.**—The mutilating operations of Schede, decortication of the lung, etc., are advisable only after prolonged treatment of a less severe nature has failed. Irrigation of the cavities with Carrel-Dakin solution and injection of sinuses with bismuth paste are among the methods which often result well.

## References


### *Bronchiectasis*

Lukens, Moore and Funk: Bronchoscopic Drainage of Pulmonary Abscess and Bronchiectasis, Med Clins. North Am., January, 1923, vi, No. 4.
Mudd: Surgical Treatment of Bronchiectasis, Jour. Mo. State Med. Assn., 1921.
Webb and Gilbert: Bronchiectasis and Chronic Bronchitis Associated with Accessory Sinus Disease, Jour. Am. Med. Assn., March 12, 1921, lxxvi, No. 11.

### *Emphysema*

Freund: Berl. klin. Wchnschr., 1912, xlix, 1695-99.
Hoover: Alveolar Air and Minute-volume of Air in Pulmonary Emphysema, Arch. Int. Med., 1913, xi, 52-65.

### *Pulmonary Abscess*

Clendening: Lung Abscess, Laryngoscope, 1922.
Pritchard: The Value of Rest in Cases of Empyema and Lung Abscess, Jour. Am. Med. Assn., Dec. 30, 1922, lxxix, No. 27.
Rich: Lung Abscess Treated with Artificial Pneumothorax, Am. Jour. Med. Sc., September, 1922, clxiv, No. 3.
Tewksbury: Acute Pulmonary Abscess. New York Medical Journal, Nov. 22, 1919.

### *Pleural Effusion*

Lyter: Am. Jour. Med. Sc., November, 1918, clvi, 665.

### *Empyema of the Pleura*

Major: Treatment of Empyema with Gentian Violet, Am. Jour. Med. Sc., September, 1921, clxii, No. 3.

### *Spirochetal Bronchopulmonary Infection*

Kline and Berger: Spirochetal Pulmonary Gangrene Treated with Arsphenamine, Jour. Am. Med. Assn., November 7, 1925, lxxxv, No. 19.
Kline and Blankenhorn: Spirochetal Pulmonary Gangrene, Jour. A. Med. Assn., September, 1923, lxxxi, No. 9.
Pilot and Davis: Studies in Fusiform Bacilli and Spirochetes. No. IX. Their Rôle in Pulmonary Abscess, Gangrene and Bronchiectasis, Arch. Int. Med., September, 1924, xxxiv, No. 3.

### *Postural Drainage*

Lambert: Pulmonary Abscess and the Treatment from the Surgical Standpoint, New York State Jour. Med., January 15, 1927, xxvii.
Mandelbaum: Lung Suppuration, Arch. Int. Med., December, 1927, xl, No. 6.

## CHAPTER XX

## DISEASES OF THE KIDNEY

### THE TREATMENT OF RENAL FAILURE

#### 1. Definition

Pathologists and clinicians have made many attempts to create a classification of nephritis which shall reconcile the clinical symptoms, and signs, with the histologic pathology found in the diseased kidneys. These attempts have been, largely, failures, the measurement of the failure being that no one classification seems to meet with the approbation of any considerable number of workers. The reason for the failure lies in the extreme variability of the histologic changes in the kidney, in relation to the comparative stability and simplicity of the signs and symptoms. The attempt has been to establish a specificity in the histologic pathology for a given sign—say chloride retention—when so specific a relationship does not exist. Furthermore in chronic nephritis of whatever kind, the histologic picture changes, not in a definite method of progression, but variably so that what is a glomerulo-nephritis at one time may be a tubular nephritis later, and an interstitial nephritis later. Remembering and making due reservations for this nonspecific character of renal symptoms and the essentially changeable nature of renal pathology, we may distinguish two broad types of pathologic and clinical nephritis.

1. *Parenchymatous Nephritis.*—a. Glomerular—due to the action of scarlatinal toxins and streptococci, among other things; associated with edema, water and salt retention, uremia and albuminous (sometimes hemorrhagic) urine, and progressing sometimes to recovery, sometimes to death.

b. Tubular, due to bichloride poisoning, the toxemia of pregnancy, and chromic acid among other things; associated with protein retention, usually oliguria, sometimes uremia and albuminuria, progressing sometimes to recovery, sometimes to death.

c. Chronic parenchymatous nephritis, a rare disease usually of young people, of unknown probably diverse etiology; associated with edema, uremia, water and salt retention, sometimes protein retention, etc., and rarely ending in recovery, usually in death.

2. *Interstitial Nephritis.*—a. Acute, due to diphtheria and scarlatina, usually in combination, a rare condition, often not causing symptoms or signs, and probably frequently terminating by healing.

b. Chronic, associated with arteriosclerosis and hypertension and accompanied by light urine, of large twenty-four amount, protein retention, and finally dyspnea, and uremia; always progressing to death.

From the viewpoint of therapeutics, however, it is quite unnecessary to establish any reconciliatory classification because *for purposes of treatment we need know only the degree and nature of renal failure.**

A parallel, which need not be pressed too far, may be found here in our consideration of cardiac failure. We pointed out that the exact anatomic condition of the heart was unimportant, but that no matter what pathology was present, treatment should be directed towards the cardiac failure. In order to help the patient we do not need to know what form of nephritis is present, but we do need to know whether the kidney is doing its work, and if not, in what respect it is deficient.

Practitioners in general do not seem to have grasped this catholic view of the nephritides. Speculation as to the anatomy may be left to others, the therapeutist need determine only the degree and kind of the renal failure.

## II. The Pathologic Physiology of Renal Failure in Relation to Treatment

**A. The Excretory Function of the Kidney.**—1. *The Excretion of Water.*—The amount of water excreted by the kidneys bears a close relation to the amount of water drunk. The most important variation is in summer, when the skin excretes a larger quantity of water and the volume of urine is correspondingly reduced. The water is not normally excreted at the same rate during the twenty-four hour period. On a fixed total fluid intake of 1800 c.c., when the urine is collected in two periods (1) from 8 A.M. to 8 P.M., and (2) from 8 P.M. to 8 A.M., the ratio between day urine and night urine was found by Jones, in normal individuals, to be 3 to 1 or 4 to 1. The amount of urine normally passed in the daytime is three or four times as much in health as that passed during the night. A disturbance of the ratio is quite regularly found in chronic interstitial nephritis—when the night urine may be equal to, or more than, the day urine.

The Mosenthal test diet is designed to measure the amount and specific gravity (concentration) of the urine. The technic is as follows:

A fixed diet and fluid intake is given. It should have water 1760 c.c., salt 8½ grams, nitrogen 13½ grams. The diet suggested by Mosenthal is detailed in the diet lists in Part I.

*I trust no one will be so foolish as to interpret this statement into an attempt to undervalue knowledge of gross and microscopic pathologic anatomy. In order that there may be no misunderstanding, however, let me state that such knowledge in my opinion is the most important equipment of the clinician.

It is very important to collect the specimens of urine at two-hour intervals: this is the only necessarily invariable part of the test. Normally there is a variation of 10 points in the specific gravity of the lightest with the specific gravity of the heaviest urine passed in the twenty-four hours. The amount of night urine is about 400 c.c. (on about 1800 c.c. of fluid intake) and the specific gravity of the first morning urine is the highest of any specimen.

In the parenchymatous and glomerular forms of nephritis with edema the water excretion is very low, and in these fluid intake should be reduced to a minimum. In the common interstitial type of nephritis the water excretion is high, the night urine rises in amount and the specific gravity, always low, varies little during the twenty-four hours.

The explanation of these facts is based more upon common sense deductions from observations than upon experiment, but there is a

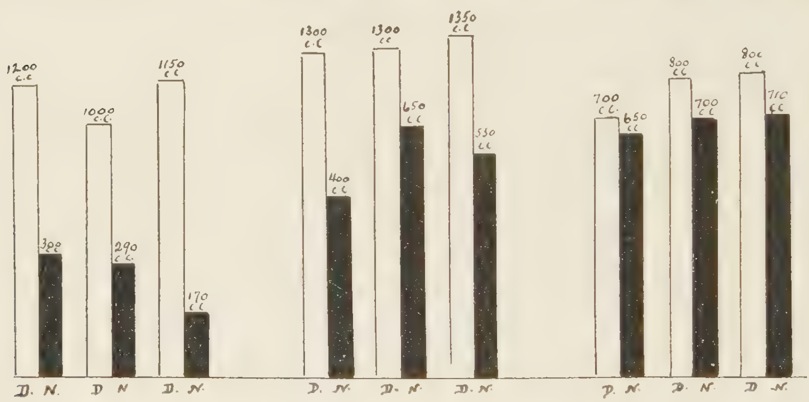



Fig. 84.—Chart of day and night urine comparisons. From left to right, normal individual; patient with hypertension and early kidney change; patient with advanced interstital nephritis.

pretty general agreement among clinicians as to the causes. The diseased kidney cannot excrete nitrogenous substances and salt easily so it has to dilute them in order to pass them through the renal filter. Inasmuch as there is potentially the same amount of these substances to be excreted, the secretion of urine must go on at the same rate, day and night.

The polyuria of Bright's disease, then, is of the same nature as the polyuria of diabetes. The treatment is to lower the ingestion of proteins and salt and thus obviate the necessity for larger amounts of water to carry them through the renal filter.

It is worth emphasizing for the general practitioner that these tests of amount of excretion, specific gravity and comparison of day and night volume are the most valuable tests we have of the functional

capacity of the kidney. They are far superior to any blood chemistry tests. They furnish the earliest information we have of the presence of renal disease. And best of all, they can be done anywhere without any special apparatus or technic.

2. *The Excretion of Chlorides.*—It is somewhat difficult to give exact figures for chloride excretion as the variation is so wide upon different diets. The concentration in the blood plasma is 0.65 per cent and there is a strong tendency to keep this figure constant so that if the kidney is not able to excrete the chlorides they become fixed in the tissues or tissue fluids.

In the glomerular and tubular or parenchymatous types of nephritis particularly, the excretion of chlorides is often much diminished, even to complete failure. Under these conditions, edema and ascites will occur and the ascitic fluid will contain enormous quantities of sodium chloride.

A salt-free diet will, many times, cause the rapid disappearance of edema of this type of nephritis. It may have to be persisted in for several weeks, when diuresis suddenly begins and the fluid disappears. In certain cases, however, the diet fails completely. This is easy to understand when there is absolutely no chloride excretion through the kidney; however, the accumulation of ascites, etc., is less while the salt in the diet is eliminated. For that reason even if no obvious improvement occurs, the low chloride diet may be very helpful. It is to be remembered that the prognosis of these cases is by no means hopeless and if the kidney is spared long enough, the renal epithelium may regenerate and function become reestablished.

In a few cases when salt-free diet has failed to relieve edema, the diet of Epstein (described below) may result in the onset of diuresis and the disappearance of the edema. The reason for this is far from evident, but has been on a few occasions an observed fact.

In chronic hypertensive interstitial nephritis, the reduction of sodium chloride in the diet has been advocated by Allen (see discussion under section on Arteriosclerosis).

3. *The Excretion of Nonprotein Nitrogen.*—The amount of nonprotein nitrogen in the blood is quite constant under a varied diet, because as soon as accumulation occurs, the normal kidney excretes the excess. It is possible therefore by making chemical examination of the blood to find the amounts of the various nonprotein nitrogenous substances and thus measure the degree of renal failure.

Under normal circumstances the total nonprotein nitrogen is 25-30 mg. per 100 c.c. of blood. A value above this may be regarded as indicating some degree of renal insufficiency. Of the individual constituents of nonprotein nitrogen, uric acid (normally 0.8 to 2.5 mg. per 100 c.c.

of blood) is the first to be retained by the diseased kidney, urea (normally 12 to 18 mg. per 100 c.c. of blood) next, while creatinine (normally 0.8 to 2 mg. per 100 c.c. of blood) accumulates only when the impermeability of the kidney becomes very marked.

Theoretically the estimation of these bodies should give us valuable information for food restriction. We must remember that creatinine is an endogenous product, arising from the ketabolism of muscle, and is independent of food intake. Uric acid and urea arise from the protein portion of the food.

As a matter of practice exact mathematical estimations of protein allowance for the nephritic are not very successful either for lengthening life or relieving symptoms. The practitioner should not be too impressed with the highly scientific appearance of the procedures to ascertain blood chemistry. They are less accurate than they look, and, except in experienced hands, are likely to utter vain things. The estimation of water excretion is far more valuable than the estimation of blood uric acid. It gives information as to the existence of kidney change far earlier than the elaborate blood analyses and can be done far more accurately.

**B. Uremia.**—In his classic Harvey Society lecture on "Nephritic Hypertension" in 1913, Dr. Theodore Janeway said that in "functional pathology, nephritis today presents the aspect of a threefold problem: the problem of edema, the problem of uremia, and the problem of hypertension." He added that the first was well on the way to solution, and "in practical therapeutics has lost most of its difficulties." The second and third he believed had baffled our best attempts at solution. If any revision of that statement is needed after the decade since it was made has passed, the fact has escaped my observation. I have indicated in other places the present state of opinion upon hypertension and edema, so we may review here the subject of uremia.

Explanations for uremia fall into two general categories. One of these is the more or less mechanical theory of Traube, who suggested, in 1860, that uremia might be due to edema of the brain and consequent cerebral pressure. This idea, although it receives little approbation from most students of the subject, is not without its attractiveness. The "wet brain" of uremia is indeed not always found at autopsy. And yet it would not be difficult to miss. Edema exists in nephritis elsewhere. Lumbar puncture often relieves the nervous manifestations of uremia. It is far from disproved that cerebral edema does not operate, at least partly in some cases of uremia.

The second theory is that some chemical substances not excreted by the kidneys flow in the blood stream and cause the symptoms. Wilson

in 1833 put out the theory that urea retention was the cause. Other investigators, however, such as Frerichs, showed that urea was relatively nontoxic when injected into animals. Ammonium carbonate was held by Frerichs to be the offending agent, while Voit, in 1868 and Linbeck, thirty years later, experimented with potassium chloride. Schottin was the first to find increased creatine and creatinine in the blood of uremics. Landois, in 1891, produced convulsions in dogs and monkeys by the application of creatin to the cerebral cortex. Feltz and Ritter, however, pointed out that it required very large doses of creatinine to produce convulsions, and even 6 gm. doses had no effect upon some of the animals used. Bouchard, in 1882, injected whole human urine and nephritic urine into rabbits. He found the nephritic urine less toxic, due he supposed to the retention of poisonous substances.

All of these experiments were done upon normal animals with good renal function. The experimental conditions were therefore not analogous to clinical conditions and the results were correspondingly contradictory. At the same time, the idea that uremia was due simply to retention of waste products which should be eliminated by the kidneys was made doubtful by the observation of animals which had been totally nephrectomized. Here with both kidneys gone, and total retention of waste products, the symptoms were as different from uremia as could well be—the striking symptom being drowsiness and asthenia. The widening of our methods of determination of the chemical elements in the blood through the work of Folin, Benedict, Van Slyke, Cullen, Myers and Fine and Marshall has served, however, to crystallize the idea that there is a definite retention of nitrogenous waste products in nephritis, but has not resulted in any considerable experimental work which elucidates the problem of uremia.

It is easy to see that the gradual accumulation of waste products, and the slow progress of disease in the excreting organ, the kidney, is a different process from the sudden removal of all kidney substance from a perfectly healthy animal. It is quite possible that an entirely new product may be formed under such circumstances. Three experiments have been published which seem to indicate this.

Foster was able to isolate a toxic base (the chemical structure of which is unknown) from the blood of severe uremic patients, which caused death in guinea pigs, preceded by dyspnea, twitchings, convulsions and coma. He also found that the nitrogen retained in the body of a nephritic (the difference between the amount in the food and the amount in the urine) was not represented by the total nonprotein nitrogen in the entire volume of blood. This led to the examination of tissues at post-

mortem, and the discovery that the waste products of kidney retention become fixed in the body cells as well as in the blood.

Hartmann isolated in 1915 a substance, $C_6H_8O$, which he called urinod. It was obtained from urine and produced nervous symptoms in man and animals.

Leiter gave urea in large quantities (130 gm. of repurified urea) intravenously to dogs and produced symptoms analogous to those found in convulsive uremia in man, including hemorrhage in the colon.

None of these three series of experiments, so far as I know, have been confirmed by other investigators.

**C. Dyspnea.**—The dyspnea of nephritis and uremia, certainly one of the most harrowing symptoms which the clinician is called upon to watch, is very probably due to acidosis. We have seen that the accumulation of acid substances in the blood will cause dyspnea. (See section on Dyspnea in cardiac failure.) Jaksch, in 1900, was an early investigator in this field. Peabody, and later Sellards demonstrated an acidosis, by the bicarbonate tolerance method, in advanced chronic nephritis, and in very advanced cases a fall in the alveolar carbon dioxide partial tension. Marriott and Howland indicated by their studies that the acidosis of nephritis is due to the retention of acid phosphates, a condition not found in diabetic acidosis.

**D. Renal Edema.**—(See Excretion of Chlorides, p. 667.)

**Summary.**—The therapeutic conclusions to which we are forced by a consideration of this morbid pathology are not very comforting. We may attempt to remove waste products by bleeding and sweating and purging. We may attempt to prevent their accumulation by removing nitrogenous substances from the diet. We may attempt to neutralize acidosis by administering alkalies. But our results have improved little since the days of Richard Bright.

### III. Some Etiologic Relationships of Renal Disease

**A. Infectious Diseases.**—Any infectious disease may cause damage to the kidneys. Scarlet fever causes perhaps the severest and most specific changes, but diphtheria, typhoid fever, measles, tonsillitis, pneumonia and many others also affect them. I have been able to find no series of cases which would tend to indicate that any preventive measures, i.e., sufficient dosage of antitoxin in the course of the diphtheria, diminish the liability to kidney damage.

In all the infectious diseases the kidney may be affected in varying degrees of severity:

1. There may be merely an albuminuria. This is almost invariable, for instance, in pneumonia.

2. There may be a general edema, with albumin and casts in the urine, running a protracted course, the patient not very sick, ending usually in recovery. The Karell diet works well here.

3. Much the same picture with the patient sicker, and the anasarca more resistant to treatment. Recovery is less frequent.

4. Fulminating cases with blood, albumin and casts in the scanty urine, and marked uremic symptoms from the onset.

**B. Focal Infections.**—Much stress should be put upon focal infections in the treatment particularly of chronic nephritis. Many observers have pointed out that nephritis progresses largely in jerks with periods of calm between.* The acute periods are initiated by an infection somewhere in the body which often lights in the kidney, particularly the glomerulus and causes destruction, thus advancing the progress of the disease.

Bell and Hartzell have published a very thorough study of a long series of cases of glomerulonephritis. In their classification of nephritis glomerulonephritis is the commonest of all forms, including "all acute and subacute and a majority of chronic cases of Bright's disease." The structural changes in the kidneys are "due almost entirely to inflammatory and degenerative changes in the glomeruli." The other forms of nephritis which they include in their classification are (1) pyelonephritis (which I take to be the acute hematogenous infections or Brewer kidney), (2) nephrosis (the chronic parenchymatous nephritis of older writers as well as the tubular destruction produced by bichloride poisoning and the toxemia of pregnancy), (3) the arteriosclerotic and hypertensive kidney (this group I suppose to be the exception they make when they say that *most* of the cases of chronic Bright's disease are glomerular).

They conclude that the evidence in favor of an infective origin for the acute cases is complete and that the subacute and chronic forms may arise from the basis of an acute inflammation or as independent forms from chronic or repeated infections. They found glomerular lesions in chronic kidneys corresponding to healing or healed stages of acute glomerulitis.

Ophüls has long held similar views, and has studied the subject from many angles. He is able to produce glomerulonephritis in animals by the injection of bacteria into the blood stream. In man he finds that the majority of the cases are due to streptococci and that a peculiar form of chronic suppurative tonsillitis due to diplostreptococci is present.

These quotations have been made in order to impress upon the student the fact that the idea of the removal of infective foci for the

*Emerson's article on "The Acute Element in the Chronic Nephropathies" should be read carefully in this connection.

benefit of nephritis rests upon experimental, and pathologic grounds. In clinical practice results may not always substantiate the extreme ground taken by many investigators. But at present the most hopeful thing we have to offer the nephritic patient is the removal of his foci of infection.

**C. Arteriosclerosis.**—The relationship between arteriosclerosis, hypertension and nephritis has been discussed under the heading of arteriosclerosis. Certainly all arteriosclerotics are potential nephritics and should be watched (focal infections removed, etc.) on that basis.

**D. The Toxemias of Pregnancy.**—The cause of the toxemia of pregnancy does not lie in the kidneys, although, in certain forms, the signs may be renal and the whole picture distinctly uremic—albuminuria, suppression, hypertension, retinal hemorrhages, convulsions, etc. And the danger of renal failure is not over after a crisis of this kind is past, i.e., after delivery and apparent recovery. I have seen four cases in which the condition passed into a chronic nephritis with hypertension, albuminuria and progressive retinal change, one patient dying of uremia thirteen years after the eclampsia. There must be many such cases. The lesson seems to me to be that the mother should be protected at the expense of the fetus (which is so infrequently saved anyway) and that we should terminate the pregnancy if possible before, and at least at the earliest moment after renal change has taken place.

**E. Metallic Poisoning.**—Mercury poisoning is the most common form of kidney disease due to metallic poisons. All cases of mercury poisoning die of nephritis if untreated. The prevention of nephritis in these cases is now perfectly possible in most cases and measures to do so should be initiated in all cases. (See chapter on antidotes, Chapter II, Part I.)

### IV. Summary of the General Treatment of Renal Failure

**A. General Management of the Patient.**—It is not in many cases, and certainly in none of the hypertensive cases of nephritis, that the physician can feel that there is much hope of recovery from the disease. The objects of treatment then must be to attempt to make the patient comfortable and to prolong life.

The first step should be to learn as much about the patient as possible. A chart should be made showing the intake and output of fluid day and night. Chlorides likewise. The blood pressure should be carefully watched over a several day period. The specific gravity variation should be done. If proper facilities are available the blood uric acid, urea and creatinine should be read once a fortnight. (The urea con-

centration test seems to be of little value and need not be done). Finally the patient should be weighed and foci of infection sought.

**B. Diet.**—When a complete study of the patient's metabolism has been made the treatment almost arranges itself. It will evidently be principally dietary. Such things as the patient is unable to excrete should be reduced to a minimum. The high, medium and low protein diet lists published under the chapter on dietetics will be found useful in the cases of nonprotein nitrogen retention.

Dr. Shattuck in Boston used to warn us that the nephritic's whole body was more important than his kidneys, and that he should not be starved. In most cases of chronic interstitial nephritis at least, this need not be considered very seriously. These patients are often overweight, have always lived well and will stand reduction in diet very well. For them I have found starvation days once a week, similar to the diabetic starvation days, to be very beneficial. In these cases of nonprotein nitrogen retention, it must be conceived that the kidney is passing out its waste products as best it can by diluting them very highly; a complete reduction in the intake of such materials should furnish the opportunity to allow the body to be entirely free of toxins for a time at least.

Two special forms of diet, useful on occasion, need a word of explanation:

*The Karell Diet* was introduced, by a Russian physician over half a century ago, but only recently has been largely exploited. Karell intended it to be used in all forms of dropsy, and indeed it is useful not only in nephritic and cardiac edema but even in cases of ascites due to liver cirrhosis. It consists simply and alone in the use of a definite amount of milk given at definite times. The total daily amount of milk given is 800 c.c. This must be administered 200 c.c. at a time at 8 A.M., 12 noon, 4 P.M. and 8 P.M. No other article of diet and no more fluid can be taken in the 24 hours. These regulations must be carried out with scrupulous exactness—why is not well understood, but all clinicians agree, with Goodman, that "the purpose of the treatment is immediately defeated if the patient is allowed to drink the milk whenever he pleases."

There will often be some discomfort experienced from thirst and possibly hunger at the beginning of the treatment. The amount of nourishment and fluid is, of course, entirely insufficient for the body's needs. But if results occur, which they should in from four days to a week, with the disappearance of the edema, the patient is willing to bear the attendant discomforts.

The great advantage of the method is its simplicity. It can be explained and carried out in any household. All clinicians know the trouble experienced in carrying out strict dietary regulations, sometimes even in a hospital. The Karell diet which automatically carries a low protein, low salt, low water content, should be instituted without any chance of misunderstanding.

The disadvantage is, of course, the insufficient intake of nourishment and fluid. All patients lose weight under the Karell diet. Most of the weight lost is due to the loss of fluid provided the method is successful in attaining its objects. But aside from that there is a considerable weakness and body loss with its use, so that it can be continued only a short time.

*The Epstein Diet.*—In special cases of nephrosis which is the name Frederick Müller proposed for "chronic parenchymatous nephritis" Epstein has introduced the use of a high protein diet.

The cases which Epstein indicates for its use are quite sharply defined. There is a tubular degeneration of the parenchyma (sometimes perhaps glomerular degeneration also). The prognosis is not hopeless; if the parenchymal degeneration is not too extensive the tubular epithelium will regenerate; and treatment which will prolong life until such regeneration begins to occur is therefore worth trying. Clinically the cases are marked by albuminuria and edema. Epstein showed that the edematous and ascitic fluid approximate the blood plasma in the contained amount of nonprotein constituents. He also pointed out the high lipoid content of the blood, the amount of cholesterol in the blood being three to six times greater than normal. Bright himself recorded the milky appearance of the serum of some cases of nephritis. In the blood plasma Epstein found a reduction of protein and a change in the ratio of albumin to globulin. (Normally the ratio is 4 to 2, or 5 to 3, but in these cases the globulin was much higher, as much as $\frac{9}{10}$ of the whole.)

From these facts Epstein argues that there is a great loss of protein from the body, carried off in the urine. The diet he employs is as follows:

Epstein Diet. Daily.

| | | |
|---|---|---|
| Food value | 1280-2500 | calories |
| Proteins | 120-240 | gm. |
| Fats (unavoidable) | 20-40 | gm. |
| Carbohydrates | 150-300 | gm. |

*Articles of food used.*—Lean veal, lean ham, whites of eggs, oysters, gelatin, lima beans, lentils, split peas, green peas, mushrooms, rice, oatmeal, bananas, skimmed milk, coffee, tea and cocoa.

He limits the fluid to the quantity present in the food, plus that which is necessary for the comfort of the individual patient amounting to 1200 to 1500 c.c.

There is no question that some cases of edematous nephritis lose their edema with the Epstein diet, when the salt-free dry diet is of no avail. But whether Epstein's theories of the underlying pathologic physiology are sound is another matter, and still an open question.

*Water Restriction.*—In certain forms of renal failure with conspicuous anasarca, water and fluid restriction is an obvious and usually successful procedure.

*Salt Restriction* is also valuable, in the same forms of nephritis in which water is restricted. Water restriction and salt restriction should go together. In other forms of nephritis, of the hypertensive form, Allen has used salt restriction also. It is a mistake to suppose that a salt-free diet cannot be made palatable. The Allen method of treatment in these cases is outlined in some detail in the section on Hypertension and Arteriosclerosis.

**C. Establishment of Other Methods of Elimination.**—1. *Sweating* has long been a popular form of treatment. It unquestionably eliminates water and salt. There is little careful observation of any kind upon it as to its actual value. Austin and Miller have studied the nonprotein nitrogen of the blood of hypertensive cases before and after sweating, finding no change whatever as a result of the sweat.

2. *Catharsis* is an obvious and frequently used form of elimination. In actual uremia, the more drastic forms of purges may be used.

3. *Venesection*, an ancient and honorable method of treatment, is not used nearly enough in these cases.

**D. Lumbar Puncture.**—In actual uremia or apoplexy lumbar puncture may do much to restore consciousness. Traube's idea of edema of the brain as the cause of uremia, with pressure on the higher cerebral centers must be remembered in this connection.

**E. Drugs.**—For discussion of diuretics, cardiac stimulants, etc., see the chapter on Drugs.

In one aspect of hypersensitive nephritis—with edema, dyspnea, and evidences of cardiac failure, even without fibrillation—digitalis and KI may form the most successful method of treatment of any aspect of renal failure.

**F. Climate.**—Nephritics do best in a warm, dry climate—Egypt or the southwestern part of America. A few unquestioned cases of cure of chronic and subacute parenchymatous nephritis have resulted from prolonged residence in Egypt.

**G. Removal of focal infection** in the teeth, tonsils, seminal vesicles, etc., are often of great symptomatic benefit and possibly even cause anatomic regression. The studies of Ophuls and of Bell and Hartzell referred to previously must be held in mind in this connection.

## II. FUNCTIONAL ALBUMINURIA: (ORTHOSTATIC ALBUMINURIA, POSTURAL ALBUMINURIA, LORDOTIC ALBUMINURIA)

Nothing could illustrate better the thesis of the preceding section—that the important thing to know in treating kidney conditions is the amount of function impaired—than the syndrome variously named functional albuminuria, orthostatic albuminuria, etc. Here we have a change in the urine (judged by a single specimen) apparently as grave as in any case of nephritis, yet with no failure of the excretory function of the kidney. Treatment directed towards saving the kidney is therefore unnecessary, and, in fact, harmful.

These cases among young persons are very frequent. The individual affected is usually unaware of the condition and it is discovered, in most instances, in the course of a routine examination, as for life insurance or other reasons. The causes for it are entirely unknown. Some theories are:

1. That it is due to lordosis. A variation of this theory is that it is an accompaniant of enteroptosis. The theory is that either the lordosis or the enteroptosis is responsible for the intestinal mesentery compressing a renal artery against the spinal column. This theory fits the fact (a true fact unlike most of those recorded about functional albuminuria) that the patients show albumin only after they have been in the erect position for some time.

2. That it is a pretubercular state. Barringer examined 70 of these cases, eleven years after the discovery of the albumin. He found that they showed 37 per cent more deaths than the average for their age and that 50 per cent of the deaths were due to tuberculosis. The incidence of the development of nephritis among them was not above the average of normal persons. This, probably the most important set of observations on the condition, has received the smallest attention from students and writers.

3. That it is due to a nondefinable acid reaction of the tissues. This is probably partially true. At any rate alkalinization of the urine will keep the urine albumin-free.

These patients are usually badly treated. The writer has had a somewhat generous experience with them and has noted that those who have been treated elsewhere are usually put on a meat-free, egg-free,

protein-low diet. This not only does not clear up the albumin, but it also deprives the patient of extra nourishment which he needs. The "correction" of imaginary spinal malpositions by fussy orthopedic methods is useless and wasteful. None of my patients had any true lordosis. The observation of Sonne that the albumin came from only one kidney (indicating that pressure of the mesentery on one renal artery is the cause) was not true in two of my cases submitted to ureteral catheterization.

The methods of treatment which have been found most valuable in my hands are:

1. Hyperalimentation. These patients are usually underweight and often enteroptotic. They need plenty of all kinds of good food and an extra glass of milk and cream morning, afternoon, and night.

2. Plenty of rest at night and plenty of fresh air. An open air life if permissible or if not one or two hours outdoors daily with mild or moderate exercise.

3. Cold baths in the morning or evening, or both.

4. Alkalinization of the urine. This method introduced by Post and Thomas rids the patient at least of his symptom—albuminuria. Any alkali will do. It should be taken until the reaction of the urine is alkaline. Whether a prolonged course of alkalies will prevent albuminuria if the patient is then allowed to do as he chooses I am not prepared to state. Martin Fischer's work showing that a state of acidity disposes protoplasm to a colloid dispersion and increased permeability may be evoked in this connection.

## III. PAROXYSMAL HEMOGLOBINURIA

This rare condition need not be mentioned at all in a work of this scope, save that the recent researches of Basil and Chester Jones show that it is always syphilitic. The use of mercury and arsphenamine together will clear the condition up permanently so that no recurrence will threaten.

## IV. HEMATURIA

Hematuria may occur in the form of essential hematuria, in which there is no organic disease of the kidney, i.e., tuberculosis, hypernephroma, stone, acute nephritis, etc. Before any such diagnosis is established, however, a careful diagnostic examination of the patient should be made by a practitioner specializing in urology, or familiar with the cystoscope. In essential hematuria the blood usually comes from a single kidney. The cause of it is unknown. It may come from the

apoplexy of a vein in a renal papilla. Exercise, riding in a car which might bump, etc., should be interdicted. I have seen several cases clear up from the removal of an infected tonsil, and once the removal of a tonsil root. Other treatment—by hemostatics such as horse serum, etc. —has little result. The cases tend to clear up—and also to recur.

## V. ANURIA

Suppression of urine may occur under various circumstances. The methods used for its relief are:

1. Intravenous glucose solution (1000 c.c. of a 10 per cent solution). This has proved the most reliable method in my experience.

2. Dry cupping, heat, poultices over the kidney region. Dr. Thompson has enthusiastically recommended the application of hot tablespoons over the loins. This is a remedy, the instruments for which are always available in an emergency.

3. Cleaning out the bowel with a hot enema and flushing it afterwards with large amounts of very hot water.

4. Diuretics—such as potassium citrate and acetate and spirits aetheris nitrosi may be tried. See section on Diuretics Chapter II.

5. The general strength of the patient and the skin elimination should be kept up with heat in the bed, hot baths, packs, etc.

## VI. PYURIA

Pus in the urine is present in pyelitis, pyelonephritis, pyelonephrosis, prostatic hypertrophy, prostatitis, seminal vesiculitis, and urethritis. It is usually a surgical condition. However, when a small number of leucocytes only are present it should be disregarded or treated medically. In men a seminal vesiculitis (not necessarily gonorrheal) is a very common cause of lumbago. Massage of the vesicles and prostate through the rectum and autogenous vaccines are the means of treatment.

## VII. PYELITIS

Pyelitis, an inflammation of the pelvis of the kidneys, may be grouped as follows:

1. Pyelitis of infancy.
2. Pyelitis of pregnancy.
3. Pyelitis of the newly married state in women.
4. Pyelitis following surgical operations.
5. Simple pyelitis falling into none of these divisions.

The cause in 75 per cent or more of cases is the colon bacillus (Kretschmer). There has been shown to be a direct lymphatic connection between

the colon (at the flexures) and the pelvis of the kidneys so that the infection is directly lymphatic borne.

Treatment should be instituted in the knowledge that in over 90 per cent of the cases the disease is self-limited, runs a course of one to three weeks, and then clears up, but has a decided tendency to return.

**Methods of Treatment.**—1. Urinary antiseptics. In my experience acroflavine is superior to hexamethylenamine. The section on urinary antiseptics in Chapter II should be consulted for administration, dosage, etc.

2. Alkalinization of the urine. In children this is usually sufficient. Sodium citrate in the amount of about 60 grains per 24 hours can safely be administered to even very young children. It should be given in water. The colon bacilli do not live well in an alkaline medium. If alkalinization does not clear up an infantile pyelitis, hexamethylenamine and acid sodium phosphate may be given for a time, and then alkalinization again used.

3. Attention to the bowels. Constipation or colitis with diarrhea should receive proper treatment. This is especially important between attacks to prevent recurrence.

4. Surgery for the rectum, hemorrhoids, fissures, etc., should be remembered in stubborn cases.

5. Lavage of the renal pelvis by a trained urologist may be recommended as a last resort in intractable or recurring cases. The solution employed by Kretschmer is 2 per cent nitrate of silver.

## VIII. STONE IN THE KIDNEY OR URETER

Stone in the kidney or ureter is usually a medical condition. The treatment, however, is of exceptional simplicity.

**Treatment of the Acute Attack.**—Morphine and atropine hypodermically in sufficient doses. By sufficient doses is meant enough to quiet the pain, beginning with morphine gr. $\frac{1}{4}$ and atropine gr. $\frac{1}{150}$ and repeating if necessary in half an hour. No other remedy is of any value. The physician who, misled by graphic accounts of the efficiency of benzyl benzoate or pantopon, withholds morphine and atropine, deserves to have a renal colic on a snowbound sleeper twenty miles from medical assistance. The attending physician when called to see a patient with a renal colic, should stay by the bedside until the patient is comfortable. Only those of us who have had these attacks realize the full force of this pronouncement.

**Treatment between Attacks.**—Instructions as to diet—abstaining from meat, tomatoes, rhubarb and salt; and the free use of lemonade and

orangeade and other fruit juices—are often issued. They may comfort fussy patients who are anxious to be having something done; but they prevent no attacks.

Large stones, of course, require surgical consultation.

## IX. TUBERCULOSIS OF THE KIDNEY

Those cases in which the tuberculosis is not extensive or suppurative and has not reached the ureter or bladder should be treated by the general means of treatment of tuberculosis—rest, fresh air, hyperalimentation, tuberculin, etc. Urologic advice is, however, always needed.

## X. SURGICAL KIDNEY—TUMOR, CYSTIC KIDNEY, ABSCESS, PERINEPHRIC ABSCESS, ETC.

Surgical kidney has no medical treatment.

### References


*Treatment of Renal Failure*

Austin and Miller: Influence of Sweat Bath on Nonprotein Nitrogen Content of Blood of Nephritics, Jour. Am. Med. Assn., Sept. 12, 1914.

Bell and Hartzell: The Etiology and Development of Glomerulo Nephritis, Arch. Int. Med., June, 1922, xxix, No. 6.

Chace and Myers: Jour. Am. Med. Assn., Sept. 23, 1916, lxvii, 929.

Emerson: The Acute Element in the Chronic Nephropathies, Jour. Am. Med. Assn., Sept. 3, 1921, lxxvii, No. 10.

Foster: Uremia, Jour. Am. Med. Assn., Jan. 29, 1921, lxxvi, No. 5.

Janeway: Nephritic Hypertension, Harvey Lectures, Am. Jour. Med. Sc., May, 1913, cxlv, No. 5.

Jones: Day and Night Urine, Jour. Am. Med. Assn., Feb. 18, 1922, vii, No. 7.

Herxheimer: München. med. Wchnschr., 1918, lxv, 283.

Leiter: Urea and Uremia, Arch. Int. Med., September, 1921, xxviii, No. 3. A good review of the subject of uremia.

Mosenthal: Arch. Int. Med., November, 1915, xvi, 733.

Myers and Fine: Jour. Biol. Chem., 1913, xiv, 283.

Ophuls: The Etiology and Development of Nephritis, Jour. Am. Med. Assn., Oct. 13, 1917, lxix, No. 15.

Volhard and Fahr: Die Brightische Nierenkrankheit, Berlin, 1914. A storehouse of facts.

*Functional Albuminuria*

Barringer, T. B., Jr.: The Prognosis of Albuminuria, with or without Casts, Arch. Int. Med., June, 1912, ix, 657.

Post and Thomas: Orthostatic Albuminuria, Jour. Am. Med. Assn., Feb. 3, 1923, lxxx, No. 5.

Sonne: Hospitalstid: June 12, 1918, lxi, 800.

*Paroxysmal Hemoglobinuria*

Jones, Basil B., and Chester M.: Paroxysmal Hemoglobinuria. Nelson's Loose Leaf Medicine.

*Pyelitis*

Kretschmer: The Treatment of Pyelitis, Surg., Gynec. and Obst., December, 1921.

Rovsing: Ztschr. f. urol. Chir, ii, No. 2.

Thomas: Tr. Chicago Urol. Soc., 1915.

# CHAPTER XXI

## DISEASES OF THE DIGESTIVE SYSTEM

### GENERAL INTRODUCTION TO THE TREATMENT OF STOMACH DISEASES

The point of view of a writer on therapeutics is quite different from the point of view of a writer on diagnosis or on special pathology. The therapeutist may entirely leave out subjects which the writer on diagnosis treats with great fullness; his classification of topics will be different, he may choose to treat apparently varied pathologic subjects under one heading. A few concrete examples as they apply to the treatment of diseases of the stomach will illustrate these abstract statements. The medical therapeutist need have no chapter on cancer of the stomach at all, although the diagnostician must treat it exhaustively. Syphilis of the stomach is a subject of fascinating interest to the diagnostician, its recognition requires judgment and knowledge; but, while nothing could exaggerate the importance of the decision to the therapeutist in practice, the writer on therapeutics need have no separate chapter on syphilis of the stomach but can include this in his general chapter on the treatment of syphilis. Again hyperacidity may be due to several different conditions. But, while the cause must be treated, the symptom in every case must also, and the treatment is about the same in all cases. These sentences are offered in explanation for the omissions and arrangement which follows.

**The Cause of Dyspepsia.**—Dyspepsia or indigestion are words which may be retained in medical nomenclature, to designate any one or any combination of the following symptoms (1) pain or discomfort referable to the stomach after meals, or before meals, (2) heart burn or acid eructations, (3) belching, (4) nausea or vomiting, (5) anorexia or lack of appetite, (6) loss of weight, (7) sallow complexion, constipation, bad taste and bad breath, (8) heaviness, burning or "caking" in the region of the stomach.

Classifying patients with these complaints we find that the underlying cause is much less often due to disease in the stomach than disease elsewhere, as the following table shows:

Causes of Dyspepsia

| | |
|---|---|
| I. *Organic Disease of the Stomach* | |
| Ulcer of the stomach and duodenum | 9.0% |
| Hypertrophic stenosis of the pylorus. | 0.5% |
| Cancer of the stomach | 2.5% |
| Rare stomach disease (sarcoma, myoma, hairball, linitis plastica, syphilis, phlegmonous gastritis, etc.) | 0.5% |

| | |
|---|---|
| II. *Functional Disease of the Stomach* | |
| Hyperacidity and hypersecretion | 6.0% |
| Achylia gastrica | 1.0% |
| Hypermotility (habit spasm, belching) | 1.5% |
| III. *Psychoneurosis—neurotic constitution.* | 18.0% |
| IV. *Habitus Visceroptoticus (Asthenia Congenita Universali, Glenard's Disease.)* | 14.0% |
| V. *Organic Disease—of Gastrointestinal Tract Outside Stomach.* | |
| Gall bladder disease | 18.0% |
| Abdominal adhesions | 2.0% |
| Colonic diseases—constipation and colitis | 9.0% |
| Liver cirrhosis and other diseases | 0.5% |
| VI. *Organic Disease Outside the Gastrointestinal Tract* | |
| Pernicious anemia | 2.5% |
| Cardiovascular disease | 1.5% |
| Migraine | 7.0% |
| Tuberculosis | 3.0% |
| Tabes dorsalis | 0.5% |
| Spondylitis | 1.0% |
| Pregnancy (early nausea, etc.) | 1.0% |
| Others | 1.0% |

Analyzing this list we find that the psychoneuroses, gall bladder disease, habitus visceroptoticus, ulcer, colitis, and migraine are the most frequent causes of symptoms referable to the stomach. Certain of the symptoms are mixed in origin: thus hyperacidity, visceroptosis, colitis and sometimes migraine have a strong psychoneurotic basis either as a complication or a cause. Some clinicians would assert that the hyperacidity syndrome (periodical recurrent epigastric discomfort relieved by food and alkalis) is always due to ulcer: in my opinion, however, the dogmas of Moynihan and Sippy have carried us to extremes in this direction. Some clinicians again would assert that achylia is always due to pernicious anemia; this is left in my list an open question.

Under the heading colitis is included all chronic cathartic consumers who do not need cathartics.

Migraine of the dyspeptic variety is likely to be called by the patients "biliousness." From discussions on the subject the reader would be liable to come away with the idea that the outstanding symptom of abdominal migraine is pain in the abdomen, but few diagnoses of abdominal migraine will be made on that basis. It is a very common disease, not always accompanied by pronounced headache and likely to have a peculiar sense of tonelessness of the bowel with a general sluggish "bilious" feeling as the outstanding symptoms.

**Relative Importance of Secretory and Motor Functions of the Gastrointestinal Tract.**—The stomach is both a gland and a hollow muscular viscus. One or the other of these functions has predominated in the minds of clinicians in different periods of medical thought as an explanation of the fundamental nature of disease or of the altered physiology of the

organ. For a long time, the secretions of the stomach were emphasized. The work of Beaumont, the pioneer investigator of the physiology of the stomach, turned largely upon the gastric secretion—its amount, its composition, its rate of secretion in response to stimuli, the work which it did. The use of the stomach tube introduced by Kussmaul, and the researches of Ewald, Boas, Pawlow, Bayliss and Starling directed the minds of men towards the secretory functions of the stomach, somewhat to the disregard of the motor functions. Of late a change is noticeable in clinical physiologic thought. Cannon was influential in initiating it, with his studies of the movements of the gastrointestinal canal as observed by the x-ray. The x-ray indeed was perhaps the most powerful influence in directing attention to the function of motion in the stomach and intestine. Before its advent, there was no clinical way for the internist to learn about gastrointestinal movements, and the surgeon was as bad off, because as soon as the abdomen is opened all gastrointestinal movements cease and the laparotomist always sees the stomach at peace, which he came to suppose was its natural state. With the conclusions of a host of observors—Holzknecht, Haudek, Cole, Case, Carmen, and Mills, for instance, on the radiologic side, and Hurst, Cannon and Washburn, Carlson, and Alverez on the physiologic side—in the clinician's hands, he was able to explain a number of symptoms in a rational manner, on the basis of the known physiology of the motions of the gastrointestinal tract.

**The Extrinsic or Intrinsic Control of Gastrointestinal Movements.**—The gastrointestinal tract is, of course, composed of involuntary muscle fibers and is hence under the control of the vegetative nervous system, the vagus being the inhibitory nerve, the sympathetic the accelerator. Some authors have attempted to explain the movements of the stomach and intestines upon a basis of the balance of these two sets of controls. Certain discoveries, on the contrary, have tended to show that the movements were controlled by chemical factors. Cannon, for instance, showed that the pylorus opened when the reaction was alkaline on the duodenal side, and that as soon as the stomach ejected a bolus of acid material through the pylorus into the duodenum, the reaction of the duodenal side then being acid, this caused the pylorus to contract. A mechanism of this kind would very delicately control the amount of food, the rapidity with which it entered the intestine, preventing an undue rush of food before the intestine was ready to receive it. The work of Bayliss and Starling also demonstrated that the hydrochloric acid of the stomach coming in contact with the duodenal mucosa caused the liberation of a hormone, secretin, which when absorbed into the blood, stimulated the flow of pancreatic juice and perhaps of intestinal move-

ment. Cole, however, showed that the stomach emptied itself at a regular rate under all conditions even when no hydrochloric acid was in the stomach and Cannon and Washburn, and Carlson showed that the stomach was constantly in motion whether full or empty.

The work of Alverez has been very important in giving us new ideas about the neuromuscular tube of the digestive tract. He showed that excised muscle tissue from various parts of the gastrointestinal tract could be caused to contract, when entirely isolated, and that the contractions were constantly stronger in segments from the upper end of the canal. He believes that there exists a metabolic gradient of peristalsis, or in other words a graduated and inherent increasing weakness of contraction of the muscle as the gastrointestinal canal is followed downward, so that at any place the muscle tissue towards the mouth is stronger than the muscle tissue towards the anus. It is more powerful cephalad than caudad. At times, in diseased states, this even rhythm is interrupted and the motions are stopped or even reversed (reverse peristalsis) with resulting symptoms of nausea, vomiting, regurgitation, etc. Mills, working with clinical material, has shown that obstruction either organic or functional (i.e., spasm) at any point in the canal tends to cause stasis above it, and even if long continued, to cause the loss of integrity of the natural valves proximal to the lesion—as ileocecal incompetence following carcinoma of the rectum (an organic defect) or spastic contracture of the rectum from irritation of the mucosa (a functional defect).

A knowledge of these facts is important. The practitioner must think of the symptoms which his gastrointestinal patients recount, in terms of physiology.

## II. DISTURBANCES OF SECRETION

### I. Hyperacidity

An increase in the content of hydrochloric acid may occur in many diverse conditions—in ulcer, gall bladder disease, chronic appendicitis, and constipation. It also occurs as the visible sign of a frequent and fairly definite form of functional dyspepsia, occurring not only in neurotic patients, but also in well-balanced individuals.

The treatment is quite satisfactory. It may range in intensity all the way from a strict ulcer diet to the ambulatory regime here detailed.

**Diet.**—The meals should often be arranged into five or six, daily, as food itself properly selected and prepared will neutralize the excess acid and tranquilize the stomach. A glass of half milk and half cream is a very good thing to order at or between meals. The best food is lean,

well-cooked meat—such as the *breast* of a *lean, broiled, spring chicken*. Mashed potatoes, eggs, thoroughly boiled oatmeal, and rice are examples of foods which are well borne by these patients.

Foods which are not well borne are spices, sour foods, pickles, raw fruit, etc., and sweets, candy, molasses, pastries, cake, etc. (the three S's—sweet, sour, and spice). White bread should always be toasted—gluten seems to stimulate the formation of hydrochloric acid. Fried foods are irritating.

**Drugs.**—The alkalies for neutralization given as in ulcer. A combination powder of calcined magnesia and sodium bicarbonate is often used thus:

℞
Mag. oxid
Soda bicarb. āā ℥ii
M. and put in wide mouthed bottle.
Sig.: Teaspoonful in ½ glass water after meals.
Repeat if necessary.

If the magnesium oxide causes too much diarrhea it can be replaced by calcium carbonate.

### II. Gastrosuccorrhea, Hypersecretion, Maladie de Reichmann

Gastrosuccorrhea is the secretion of gastric juice continuously irrespective of the presence of food in the stomach. It may be continuous or periodic. The local treatment is by diet, drugs, and lavage. The general condition of the patient should be toned up with exercise, massage, hydrotherapy and sojourns at mineral springs.

**Diet.**—The excess of hydrochloric acid always present in the stomach makes carbohydrate digestion incomplete. Ptyalin is neutralized as soon as the food reaches the stomach. The food should therefore be mainly animal protein—meats and eggs. The meals should be small and frequent.

**Drugs.**—The alkalies are used in large doses. Atropine in very large doses is obviously indicated, either hypodermically or by mouth.

**Lavage** is the mainstay of treatment in these cases. It should be done once, twice or three times a day as is necessary. A solution of 1:10,000 silver nitrate may be employed if the ordinary lavage water is ineffective.

### III. Achylia Gastrica

Absence of hydrochloric acid in the gastric contents may occur in organic diseases such as cancer of the stomach, cancer elsewhere, pernicious anemia, linitis plastica and some cases of gall bladder disease, etc. It also occurs as an independent entity.

**The diet** for these patients should be appetizing and high in caloric value. Fats should be emulsified—butter and cream may be given freely. The fat in meats, as bacon, is not well tolerated. All meats should be thoroughly cooked, in order to render them easily digested with little gastric juice or easily passed into the duodenum. Meats should often be minced or chopped. The connective tissue must be gelatinized by cooking so that the meats eaten should be boiled or broiled much longer than for ordinary purposes. The starches should be well cooked and ground up also. Purees are advisable. Soper has found fermented milk, orange juice and grape juice valuable because lactic and citric acids powerfully stimulate the pancreatic functions. Above all the diet should be *liberal;* force feeding if necessary.

**Drugs.**—The artificial digestants should be tried here if anywhere. Dilute HCl in 15 and 20 drops or even more should be given throughout the meal. This will do much to relieve the diarrhea which occurs in about half the cases. Some patients do not tolerate HCl well; in these there seems to be an associated gastritis, but in pure achylia it usually acts brilliantly.

If a careful regime is followed the patient may live some time in comfort, even though the acid never reappears.

## III. TREATMENT OF ULCER OF THE STOMACH AND DUODENUM

**Summary.**—

1. Data required—x-ray proof of existence of ulcer, gastric analysis, analysis of the stools for blood.
2. Selection of cases for:
    a. Surgical treatment.
    b. Medical treatment.
3. Selection of medical cases for:
    a. Absolute rest.
    b. Ambulatory treatment.
4. Objects of treatment:
    a. To allow the ulcer to heal, by covering the granulating surface with epithelium.
    b. To relieve pyloric obstruction.
    c. To maintain body nutrition.
    d. To prevent, if possible, complications.
    e. To prevent gastric infection.

5. Accomplishment of these objects:
    a. By rest of the stomach—recumbent position, ice bag to the epigastrium, small, frequent feedings of a bland (milk, cream and egg) diet.
    b. By neutralization of excessive acidity—diet, drugs.
    c. By removal of stagnant gastric contents from the fasting stomach—gastric lavage at night.
    d. Removal of oral sepsis.
6. Special technic of:
    a. Diet.
    b. Drugs.
7. Outline of classical forms of treatment:
    a. Leube.
    b. Lenhartz.
    c. Sippy.
    d. Smithies.

### I. Selection of Cases for (a) Surgical and (b) Medical Treatment

There is no doubt, in spite of heated controversies by internists and surgeons, that certain cases of gastric ulcer do well after surgical treatment. There is also no doubt that certain of them are cured by medical means and are better in that way. The first duty, then, for the physician is to determine, in each individual case, which method of treatment is best for it. The cases usually recommended for surgery are of four varieties:

1. Perforation of the ulcer.
2. Hemorrhage.
3. Obstruction of the pylorus.
4. Carcinomatosis degeneration of the ulcer.

1. **Perforation** is, of course, distinctly a surgical complication. Hardly one patient in two hundred (I can find no exact statistics) with perforation of a gastric or duodenal ulcer survives without an operation. When the patient lives it is due to the plugging up of the perforation by a piece of omentum and consequent adhesions may cause very serious symptoms. In these cases, too, septic material that has already escaped into the peritoneum will probably cause abscesses which, even if they absorb, result in extensive adhesions. Even under these rare favorable conditions, then, perforation becomes eventually a surgical disease.

The earlier the case is operated upon, after the perforation has taken place, the better will be the result. Moynihan has had 66.6 per cent of recoveries in 27 of these cases. Deaver, out of 43 cases, lost none

operated in the first twenty-four hours. Aaron states that the mortality is 28 per cent within ten hours, 65 per cent if delayed beyond twenty-four hours.

It is part of the physician's duty, therefore, to become familiar with the early symptoms of perforation. Moynihan states:

"The perforation of an ulcer of the stomach is a catastrophe which, in my experience, never comes unannounced. In all patients there has been trouble, of a greater or less degree of severity, from the ulcer. In many of the patients the symptoms have persisted for months, and in some they have been of greater severity in the weeks or days preceding the rupture of the ulcer.

"When perforation occurs, there is a sudden, agonizing pain, a pain which almost reaches the limit of human endurance. But there is neither shock nor collapse, as a rule. The pulse at the first is not rapid, and the abdominal muscles may not be rigid. It is well to insist upon these points; for, now that the surgeon is asked to see these cases almost immediately after the occurrence of the perforation, delay may be considered necessary if the pulse rate is not quickened, and if collapse and rigidity of the abdominal muscles are absent. Exquisite tenderness of the skin I have always found. The least stroking of the surface with the finger is resented. Tenderness and pain on pressure, though general, are often present in a greater degree at one part than at another. So constantly is this the case that a careful examination of the abdomen will almost always permit of an accurate localization of the position of the ulcer which has ruptured. The onset of those symptoms formerly considered as necessary to a diagnosis—collapse, abdominal distention, rapidity and smallness of pulse—should not be allowed to develop. A diagnosis can be made from the history of ulcer, the sudden onset and the continuance of intolerable pain, restriction of thoracic movements, surface tenderness, and abdominal rigidity, or restriction of the normally free abdominal movements."

2. **Hemorrhage.**—Surgeons advise only one type of bleeding ulcer for operation. They do not advise operation in hemorrhage in acute ulcer, or, in the chronic ulcer, when the hemorrhage is (1) latent, or concealed, in which cases it is trivial; (2) is intermittent, in moderate quantity, in which case the life of the patient is seldom in jeopardy. The class of cases of hemorrhage in chronic ulcer in which operation is recommended, is that in which the hemorrhage occurs "generally, but not always, after a warning exacerbation of chronic symptoms. It is rapidly repeated, is always abundant; its persistence and excess cause grave peril, and will if unchecked be the determining cause of the patient's death."

However, even experienced surgeons are not by any means hopeful that they can always find the bleeding vessel, or that if found it can be successfully ligated. Moynihan, operating on 33 cases of hemorrhage, had a mortality of 18 per cent. In general, surgery plays a small part in the treatment of hemorrhage from ulcer.

**3. Obstruction of the Pylorus.**—When obstruction of the pylorus is severe, as evidenced by vomiting regularly after eating, loss of weight and frequent recurrence of severe attacks, and when medical treatment gives no relief, the operation of gastroenterostomy or of pyloroplasty may be recommended. Both of these operations have for their object the provision of a new opening from the stomach into the intestines. In properly selected cases they are usually successful. From a study of cases at intervals of from two weeks to eleven years after operation, the writer has gained favorable opinion of the effects of gastroenterostomy, and believes that the operation itself seldom does harm.

*End Results.*—Moynihan (1908) states that of 281 patients operated upon 211 were well several years after operation. Mayo (1908) claimed a cure upon 80.7 per cent of his cases. Lockwood (1911) studying the combined statistics of seven surgeons found that they claimed cures in from 76.5 per cent (the lowest) to 93.9 per cent (the highest). Joslin, a physician, (1914) reported that of 70 of his own private cases which were operated upon 47 per cent were well, 19 per cent were relieved, 14 per cent were unrelieved, and 20 per cent were dead.

**4. Carcinomatous Degeneration of Ulcer.**—At present we have absolutely no reliable method of determining whether this ever occurs and if so how often. Obviously it is surgical, from the beginning. But to use it, as some surgeons do, as a basis for urging operation upon patients with gastric ulcer, is unscientific.

### II. Selection of Medical Cases for (a) Absolute Rest and (b) Ambulatory Treatment

When the decision has been made that a case is suitable for medical treatment, the question arises whether the patient must be put to bed in a hospital or whether he can be treated while up and about his daily routine. Sometimes this is very easy to answer, sometimes very difficult. The severe case of hemorrhage, or of vomiting obviously is a hospital case. The patient with a little blood in the stool, and mild to moderate discomfort after or before meals, can usually be successfully treated while up. Between these extremes range all sorts of variations.

In general every case is better kept a week in bed—educating the patient in the technic of ulcer treatment, and giving the stomach the benefit of rest.

If bed treatment is decided upon, by all means it should be begun in a hospital, where the nurses and attendants are familiar with the technic of ulcer treatment. Later the patient may go home, but only after he is educated.

## III. Objects of Treatment

The ideal treatment of a gastric or duodenal ulcer would be to cut it out. Knowing nothing of the cause of ulcer, and with excisions usually regarded by surgeons as an unsuccessful procedure, we are forced to fall back upon the institution of such measures as will best promote the healing of the ulcer by natural means. The surface of a gastric ulcer, under proper conditions, will be covered by granulation tissue and finally by scar tissue and regenerated epithelium just as will any other defect in the continuity of a mucous membrane.

In accomplishing this object, which we do by rest and a bland, easily digested diet, and by the removal or neutralization of excessive gastric acid secretion. which tends to prevent healing, we also relieve the spasm or obstruction of the pylorus, the cause of a great many of the troublesome symptoms of the disease. We must always be on our guard to see that, in the presence of a smaller diet, the patient's body nutrition and weight are maintained. Generally patients gain weight on ulcer treatment. Classical forms of treatment also tend to prevent perforation and hemorrhage.

## IV. Accomplishment of These Objects

Every one is agreed that **rest of the stomach** is a prime desideratum in ulcer. Rest in bed helps to do this. An ice bag to the epigastrium lessens gastric motility.

A **diet** which puts no strain on the secretory or motor activities of the stomach is perhaps most important of all. Small amounts of food will be more quickly and easily digested. The feedings may be given frequently in order to supply sufficient caloric value. Foods are selected which are easily digested, have little residue and neutralize hydrochloric acid in high proportion.

**The neutralization of excessive acidity** is the fundamental basis of most ulcer treatments. That the excessive acidity and amount of gastric secretion in ulcer is the cause of the ulcer cannot be proved. That they tend to prevent healing is probable.

**Removal of stagnant gastric juice** by the stomach tube once in the twenty-four hours, usually at night before the patient goes to sleep, is one of the most important and in some cases the most important sin-

gle factor in the treatment. This stagnant, highly acid fluid remaining and accumulating all night will undo all that has been accomplished in the daytime. Removing it will render unnecessary excessive administration of alkaline drugs. Patients usually learn to swallow an Einhorn or Rehfuss tube with no difficulty. These tubes are best adapted to the quiet easy removal of gastric contents. This procedure (of removal of excessive secretion before retiring) is in my experience the most frequently neglected thing in ulcer treatment, and is the most frequent cause of failure of such treatment. It need not be continued indefinitely. When the symptoms improve, the amount of secretion tends to lessen, and daily removal may be discontinued.

Another point frequently neglected is to treat oral sepsis before beginning treatment. Pyorrhea, decayed teeth, infected nasal sinuses will all drop pus and decayed organic material into the stomach and continue gastric infection and reinfect new areas, possibly causing new ulceration.

### V. Special Technic

**a. Diet.**—Foods to be used in gastric and duodenal ulcer, like the foods used in hyperacidity, must have three virtues:

1. They must not excite the production of HCl.
2. They must have a high combining power with HCl.
3. They must leave the stomach rapidly, and have no residue.

The animal albumins have the highest combining power and lowest exciting power for HCl and, after carbohydrates, leave the stomach soonest. Hence milk, egg whites, and lean meats are articles of choice. Cannon demonstrated that carbohydrates left the stomach first, protein foods next, and fats remained the longest. Generalizations from his work, however, cannot be exactly applied. Experience teaches most ulcer patients what foods can and what foods cannot be eaten with comfort. Certain fats—cream and olive oil—have a good combining power and low exciting power, while fried foods and frying fats are irritating. Molasses, maple syrup and candy seem to stimulate some individuals to a large flow of gastric juice. White bread is acid-stimulating as shown in its use for test meals; toast, however, is well borne. Pickles are very irritating, probably because they stay in the stomach a long time and have a good deal of residue. Oatmeal, rice, farina and other cereals should be cooked a long time—two to four hours—in order to break up all the cellulose capsules. Early in the treatment of most ulcers the mainstay must be milk, cream and eggs,

possibly custards and cereals. Later lean meats, toast, mashed potatoes, creamed soups, jellies, creamed spinach, and cooked fruits may be added. Tea and coffee usually do no harm.

Besides the kind of food, the amount of food and time of ingestion must be considered. A small amount of food brings out less acid, and puts less burden on the stomach than a large amount; frequently repeated this neutralizes the largest possible amount of acid, and stimulates the smallest possible production in the twenty-four hour period.

Crohn and Reiss have studied the effect of ulcer diets upon the secretion of the stomach, with continuous removal of gastric juice. Both milk-cream mixture and calcium-carbonate-soda powders bring the acid curve down.

**b. Drugs.**—The following drugs have been recommended at one time or another for the treatment of gastric and duodenal ulcer:

| TO NEUTRALIZE ACID | TO COAT THE SURFACE OF THE ULCER | TO PROMOTE HEALING |
|---|---|---|
| Alkalies: | Bismuth subnitrate | Silver nitrate |
| Sodium bicarbonate | Bismuth subcarbonate | Tr. iodine |
| Calcium carbonate | Bismuth subgallate | Olive oil |
| Magnesium oxide | | |
| Secretory inhibition: | | |
| Atropine or belladonna | | |

The dosage and characteristics of these drugs have been discussed in the Section on Drugs. A word or two in addition is put down here.

*The Alkalies.*—In gastric and duodenal ulcer and allied conditions, these drugs are given in such large quantities—in one form of ulcer, Sippy advocates as much as three ounces each of calcium carbonate and of soda bicarbonate day after day—that it behooves the physician to know their characteristics very minutely. They can cause alkalosis. The signs are a general edema and heavy alkaline urine. For this reason it is always well to stop them at intervals for a few days. Calcium carbonate is probably the safest: almost unlimited quantities of it can be taken. It has a good neutralizing power for acid, and also coats over the ulcer surface. It is the powder of choice after hemorrhage.

It should be remembered that magnesium oxide can cause diarrhea, which may be so annoying as to demand its withdrawal. Some clinicians have said that sodium bicarbonate, while it neutralizes acid gastric juice, at the same time stimulates the production of acid. In practice, however, no such effects are observable.

*The Bismuth Salts.*—It was once considered that bismuth coated over the surface of the ulcer. Since its extensive use in x-ray work on the gastrointestinal canal a few years ago, before its replacement with barium, such ideas have had to be discarded: the bismuth meals leave

the stomach completely, with no coating on the ulcer surface. That bismuth can cause poisoning, with deposits in the gums, etc., was the reason for its being discarded in x-ray work.

*Silver Nitrate.*—Lockwood has advocated the use of silver nitrate in gastric and duodenal ulcers, in cases in which pain persists in spite of other treatment, "especially in those ulcers with clean tongues and regular bowel functions which are accompanied by a heightened acidity, and usually with persistent pain." He puts it in solution as follows:

| | | |
|---|---|---|
| ℞ | | |
| Argenti nitratis | gr. xvi | 1.03 |
| Aqua dest. | ℥ ii | 60. |
| M. and ft. sol. | | |
| 5 minims—1/6 gr. (.01 gm.) | | |

Lockwood recommends giving it in a nine-day cycle:

1st 3 days—15 minims 3 times a day half an hour before meals.

2nd 3 days—20 minims half an hour before meals.

3rd 3 days—25 minims half an hour before meals.

*Olive Oil.*—Cohnheim originally advocated the use of olive oil. Its action is clear. It is a fat which diminishes gastric secretion, and is soothing. A wineglass full before meals is the usual prescription. It is said that in ulcers which cause pain after operation olive oil is particularly useful.

*Tr. Iodine.*—Five drops in a half glass of water on an empty stomach three times a day has been recommended for pain when all other agents have failed.

**c. Nonspecific Protein Injections.**—Martin has reported 83.2 per cent of favorable results from intramuscular injections of purified milk in peptic ulcer.

### VI. Classical Forms of Treatment

**A. Leube.**—Leube's is one of the older plans for ulcer treatment.

*First 14 days*—rest in bed. A hot poultice, changed every 15 minutes, to the epigastrium. Every morning, an hour before breakfast, ½ a pint of Carlsbad water is given.

A tablespoonful of milk and cream is given at regular intervals, ½ a pint being given the first three days, ½ a liter after the first week.

*After the 2nd week*—bouillon and soups are added, eggs, breast of chicken, squab, flour soups, egg dishes, mashed potatoes, crackers and zweibach.

**B. Lenhartz.**—Lenhartz thought that the Leube treatment was too weakening. (There are only from 350 to 1200 calories a day provided in the first 14 days of the Leube treatment.) He advocated a treat-

ment which calculated to supply an adequate caloric intake from the beginning. His assumption was that treatment should begin on the day a hemorrhage has occurred. The treatments of 25 years ago were all constructed in fear of starting new hemorrhages by the introduction of food into the stomach. Lenhartz was a pioneer in showing that food could be given immediately. A tabulation of his diet is given in Table XXVIII.

The milk is advocated at first in teaspoonful doses. The eggs are beaten up entire with some sugar, and the cup containing them is put on ice. Lenhartz believed in the binding power of egg albumin and other proteins for hydrochloric acid; so his diet contains a great deal of protein. He advocated *30 grains (2 gm.) of bismuth subnitrate three times a day,* for the first 10 days of his regime.

**C. Sippy Treatment.**—In 1915, Dr. B. W. Sippy, of Chicago, gave out a technic for the medical treatment of ulcer which he had used for twelve years, and which gave him justification for believing that most ulcers, even those usually regarded as surgical, could be successfully relieved and healed by this method. The technic has been very widely adopted by American clinicians, and has been enthusiastically endorsed by some of the most conservative of them. I would, by all means, recommend it as the routine treatment in any clinic or hospital. It is based in general upon the principle of the practically complete neutralization of the acidity of the gastric juice. Sippy believes thoroughly in excess acidity causing the ulcer, or at least causing its continuance. The neutralization is effected by very large doses, frequently administered, of alkalies, and by hourly feedings of a mixture of equal parts milk and cream. If complete neutralization is not accomplished at first, as shown by the gastric contents aspirated from the patient's stomach at night, more alkalies are administered.

It is well to ponder on these principles before attempting to arrange the details of a treatment. The Sippy treatment differs from all previous treatments in two respects: (1) the large amounts of alkalies frequently administered and (2) the very exact and specific timing, dosage and administration of foods and alkalies. The last point is especially noteworthy.

*The chief cause of failure in the medical treatment of ulcer is inattention to details of technic.*

In the last summary of his views Sippy details plans for three types of cases:

**Sippy Treatment of the Nonobstructive Type of Ulcer.**—

1. *Rest in bed* for three weeks. The patient may sit up part of the day, and after the first week take short walks.

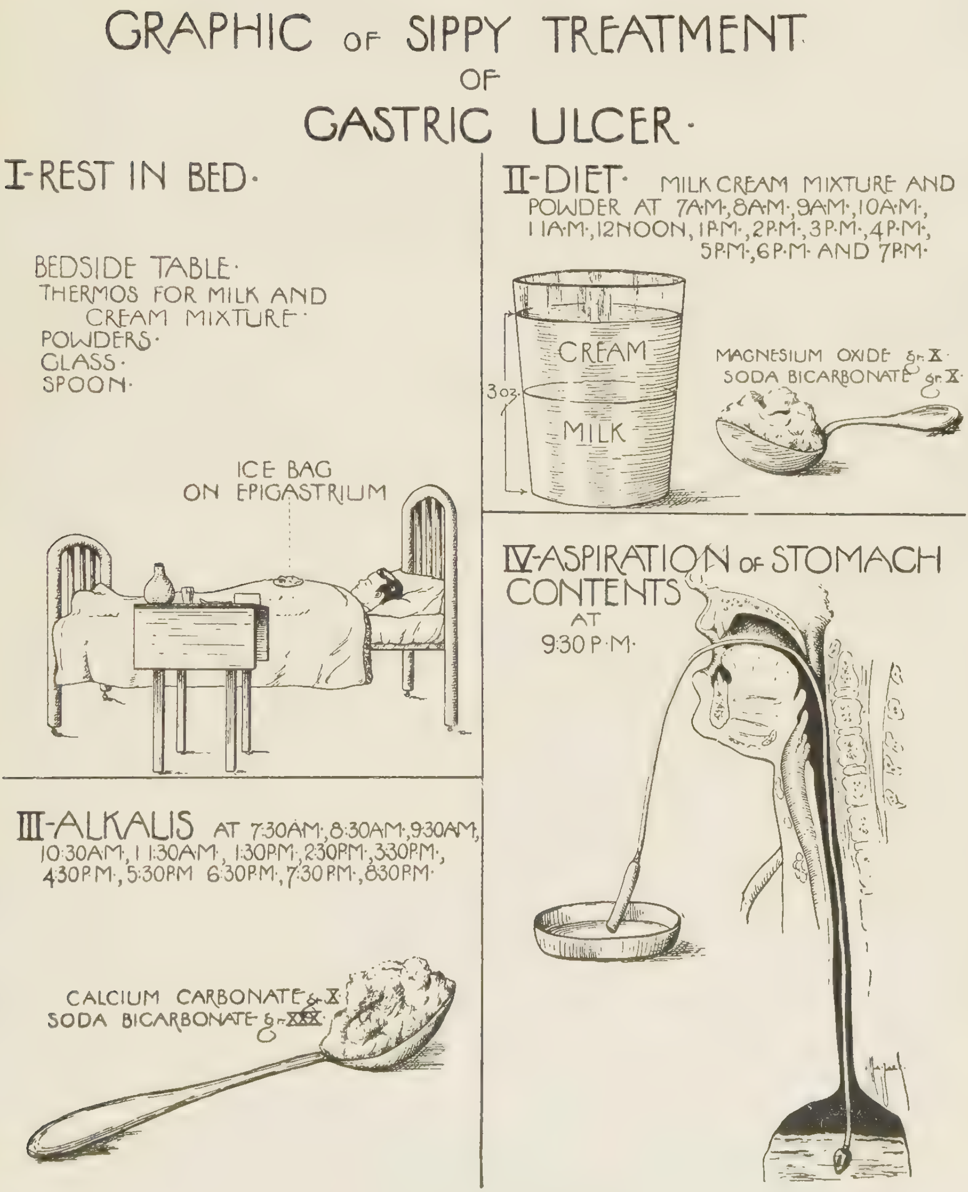



Fig. 85.—Sippy treatment.

TABLE XXVIII

DIET IN ULCER OF THE STOMACH

| DAYS AFTER HEMORRHAGE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Eggs | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| Milk (mils) | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| Sugar to the egg (gm.) | | | 20 | 20 | 30 | 30 | 40 | 40 | 50 | 50 | 50 | 50 | 50 | 50 |
| Raw beef (gm.) | | | | | | 35 | 35×2 | 35×2 | 35×2 | 35×2 | 35×2 | 35×2 | 35×2 | 35×2 |
| Milk rice (ground rice) (gm.) | | | | | | | 100 | 100 | 200 | 200 | 300 | 300 | 300 | 400 |
| Zweiback (gm.) | | | | | | | | 20 | 40 | 40 | 60 | 60 | 80 | 100 |
| Raw ham (gm.) | | | | | | | | | | 50 | 50 | 50 | 50 | 50 |
| Butter (gm.) | | | | | | | | | | 20 | 40 | 40 | 40 | 40 |
| Calories | 280 | 420 | 637 | 777 | 955 | 1135 | 1588 | 1721 | 2138 | 2478 | 2941 | 2941 | 3007 | 3073 |

2. *Diet.—A mixture of equal parts milk and cream* is the only food at first. It is kept cold in a thermos bottle or citrate of magnesia bottle corked and sitting in a pitcher of ice water. It will be called here the M-C mixt.

*First 3 days*—3 ℥ (90 c.c.) M-C mixt every hour from 7 A.M. to 7 P.M.

*After 3 days*—(1) a soft egg or a piece of toast is added to one forenoon feeding. (2) 3 ℥ (90 c.c.) weighed after cooking, of well cooked oatmeal, rice or farina is added to an afternoon feeding.

Egg and cereal are gradually added so that by the end of the first week, the schedule is:

3 ℥ M-C mixt. every hour 7 A.M. to 7 P.M.

At the 10 A.M., noon and 2 P.M. feeding, add a soft egg.

At the 11 A.M., 1 P.M. and 3 P.M. feeding add 3 ℥ cereal.

Custards, cream soups, and vegetable purées may at times be substituted for the M-C mixt.

After the fourth week, the patient leaves the hospital and goes on the routine which is to be followed for at least one year; it is detailed below.

3. *Alkaline medication.*—

Two powders are made up:

| | | | |
|---|---|---|---|
| I. ℞ | | | |
| | Heavy calcined magnesia | gr. x | .6 gm. |
| | Sodium bicarbonate | gr. x | .6 gm. |
| II. ℞ | | | |
| | Calcium carbonate | gr. x | .6 gm. |
| | Sodium bicarbonate | gr. xxx | 2. gm. |
| | mix | | |

For the first weeks of treatment powder No. I is given with every feeding of the M-C mixt. 7 A.M. to 7 P.M.

Powder II is taken every hour between feedings—that is at 7:30 A.M., 8:30 A.M., 9:30 A.M., etc.

After the 7 P.M. feeding, one of these powders is given every half hour for 4 or 5 doses.

4. *Aspiration of the stomach contents* is done two afternoons and three evenings of each week until the physician is satisfied that there is no gastric residue and that the acidity is completely neutralized. At first the evening aspiration should be done one-half hour after the last powder is taken, that is at 9:30 P.M. If much secretion is found, Powder II should be taken again at 10:30 P.M. and 11 P.M. and another aspiration done at 11:30 P.M. If this aspiration shows considerable secretion

(20 c.c. can be considered normal) the powders should be continued every hour all night for a few nights. If it is normal, the powders should be continued to 11 P.M. When the 9:30 aspiration shows a normal amount of secretion and acidity on several consecutive occasions, the aspirations can be stopped as a routine, and done only for observation once a week or once every two weeks, and the night powders can be omitted.

*Routine Treatment after the Fourth Week.*—To be continued for at least one year.

Three small meals daily with milk-cream mixture at hourly intervals, and powder on the half hour. The total bulk of any one meal should not be more than 10 or 15 ounces (300 to 450 c.c.). The character of the meal has been indicated above: eggs, toast, cream soups, mashed potatoes, spinach, soft cooked tomatoes, cooked fruits, custards, cereals, gelatin, whipped cream desserts, milk toast. Meat and meat broths interfere with stool analysis for blood. They should not be given for four days preceding such a test.

After breakfast a powder should be taken every half hour for two or three doses, then about 10 A.M. 3 ℥ (90 c.c.) of the M-C mixture. Half an hour later a powder, M-C mixt. and powder alternating every half hour until noon. After the noon meal a powder every half hour for 3 doses, then M-C mixt. and powder alternating every half hour. The evening meal should be small, 8 to 10 ℥ (240 to 300 c.c.). After supper a powder every half hour for four or five hours.

Aspirations should be done once a month at least. If the tube shows the stomach empty half an hour after the last powder, aspirations need not be done oftener than once a month.

Now and then the patient can take a regular meal to vary the monotony.

The patient must make arrangements to carry the M-C mixture wherever he goes—to the office, etc. It can be carried in a pocket flask.

*Important.*—All powders should be stopped for five days at the end of the tenth week. Thereafter every six weeks, the powders must be stopped for five or six days.

**The Treatment of the Obstructive Type of Case.**—It may seem strange to those unfamiliar with Sippy's doctrines that medical treatment is recommended in pyloric obstruction, but Sippy maintains that much can be done for those cases. This is because the obstruction is often due to inflammatory edema around the ulcer, not to organic cicatrix and can be relieved by treatment of the ulcer.

The treatment of the obstructive type differs from that of the non-obstructive type only in that rest in bed is absolutely maintained, and that more alkali is given: as much as:

| | | |
|---|---|---|
| Calcium carbonate | | |
| Sodium bicarbonate | āā gr. xxx | 2. |

every hour and every half hour after the last feeding up to midnight. The M-C mixture is given as in the other plan. *Enough alkalies are given to control the acidity, and the treatment is continued at bed rest until the progress is satisfactory or until it is evident that operation is necessary.*

Aspirations are more necessary in this than the nonobstructive type. They should be done at 9:30 P.M. and at 11:30 P.M. If 100 c.c. of strong secretion is found at 11:30, give the next night a powder after the 9:30 aspiration and every half hour until the 11:30 aspiration. The night secretion will disappear when the acidity is thus controlled. Secretion begets secretion. If 20 c.c. of secretion is found at midnight, that is normal; aspiration should then be continued for two to three weeks or until obstruction disappears.

**Treatment of Hemorrhage. Bleeding Ulcer.**—Bleeding ulcer assumes a large hemorrhage with bloody vomiting and moderate to severe exsanguination.

The principle of treatment is to neutralize all gastric acidity and stop stomach movements.

*For the first two days.*—Rest in bed, a preliminary hypodermic of morphine and atropine if necessary. Ice coil to epigastrium. If hemorrhage is severe enough elevate the foot of the bed. Do not give salines by bowel or under skin.

No food by mouth for three days.

Drugs: Alkaline powders are given from the beginning. Calcined magnesia is preferred to sodium bicarbonate as it causes gentle bowel movements and prevents gas formation.

Calcined magnesia gr. lx (4 gm.) should be given at first. Then a powder containing:

Calcined magnesia
Calcined carbonate āā gr. xxx (2 gm.)

is given every half hour, or simply calcium carbonate gr. xxx every half hour for 10 or 12 hours. After this it can be given every hour for the next 10 hours, so that sleep will not be broken every half hour.

*Second day:* Calcium carbonate gr. xx every half hour during the day, and gr. xl every hour during the night.

On the third day begin the M-C mixture and continue treatment as for nonobstructive types of ulcer.

**D. Smithies' Treatment.**—In 1920 Smithies published a criticism of the alkaline treatment of gastric ulcer. It was obviously directed at the Sippy treatment. He reviewed the arguments against the belief for excessive acid as a cause of ulcer; and presented an etiologic-therapeutic classification of ulcer. He outlined, later, a plan for ulcer treatment as follows:

1. Rest in bed.
2. Physiologic rest to the stomach, no drugs, no lavage.
3. Local application to the abdomen.
4. No food by mouth for four to seven days. Paraffin wax may be chewed and rectal feedings instituted.
5. After mouth feeding is begun, based on Cannon's observations that carbohydrates leave the stomach quickest, barley water, rice gruel, thin cream of wheat, etc., are given.

Under this regime he believes that the exhibition of large amounts of alkali are unnecessary. The views of Smithies are valuable in pulling us back from too rigid belief in Sippy's conclusions, but the Sippy treatment works in practice and is likely to hold its own.

## Results of Medical Treatment of Ulcer

1. Relief of symptoms.

**Joslin's statistics (1914) on 131 patients treated medically:**

| | | |
|---|---|---|
| Well (after several years) | 39 % | 81% |
| Relieved | 42 % | |
| Unrelieved | 12 % | 19% |
| Dead | 7 % | |

Lockwood's (1911) cases followed over 3 years:

| | |
|---|---|
| Cured | 66.6% |
| (Of these 16.6% afterwards relapsed) | |
| Improved | 22.2% |
| Unimproved | 5.5% |
| Dead (not as result of ulcer) | 5.7% |

**Leube (1897)—556 cases:**

| | |
|---|---|
| Cured | 74.1% |
| Improved | 21.9% |
| Unimproved | 1.6% |
| Died | 2.4% |

2. Roentgenologic observation of healing of ulcer.

Hamburger was the first to publish observations on this subject. The favorable effect of medical treatment of gastric ulcers can be seen quite often on the x-ray plate.

## IV. VISCEROPTOSIS (GASTROPTOSIS; ENTEROPTOSIS; GLENARD'S DISEASE; CONGENITAL UNIVERSAL ASTHENIA)

### I. Definition

Visceroptosis is one of the most common and most important conditions which the physician encounters. Important, first, because it is so common; second, because the patients are, in four-fifths of the cases, marked from birth to be invalids; third, because they are generally so badly treated; fourth, because the condition is so little understood, and last because so much can be done for them by proper methods.

The first point, which I want to make about them is that the whole body is abnormal, and that therapy, to be effective, must consider the whole individual and not simply a part. The patients at one time or another usually have digestive symptoms; the gastroenterologist, if consulted, finds an atonic stomach low in the abdomen with intestines also dropped. The condition is then called gastroptosis or enteroptosis. It is considered in medical works under that title. This is only part of the picture. It is not the stomach or bowels alone, it is the whole body which is abnormal. The best name for the condition is not gastroptosis or even visceroptosis but universal congenital asthenia. (There is an acquired form of gastroptosis which will also be considered).

The patients are good friends of the medical profession. No gastrologist, internist, neurologist, rhinologist, surgeon, even pediatrician but has some of them upon his list, and, unfortunately, no Christian Science church, osteopath, chiropractor, mental healer or quack, but has a collection of them who have tried the legitimate profession and abandoned it, because they were not helped. This is to a certain extent inevitable and to offset it the profession in many circles is becoming alive to the proper handling of these people. But the pity of it is that so much can be done to help them which is not done. The most common mistake seems to be to treat a part instead of the whole. The appendix is removed, (and often many other operations follow) the uterus is straightened, the mind is psychoanalyzed, the tonsils are enucleated, the thyroid is x-rayed; or even one part of the rational treatment is proposed—a corset put on, a diet arranged—but the body is not seen as a whole.

### II. The Relation of Body Form to Symptoms and Pathology

The physique of these individuals is the keynote of treatment. All human bodies are not alike. In general three main types can be distinguished:

(1) *The normal, medium type.*

(2) *The broad heavy type*—herbivorous (Goldthwaite), hypersthenic (Mills) and

(3) *The narrow, light type*—carnivorous (Goldthwaite), asthenic (Mills), asthenia universalis congenitalis.

Every possible subvariety may be differentiated so that a line of human beings could be set up, ranging from the thin long weak visceroptotic at one end to the broad heavy strong Clydesdale at the other, and, yet any two bodies side by side would show a difference almost imperceptible. None of these bodies need be definitely pathologic—none the seat of actual anatomic disease. And yet by the very nature of their physique they (at least the more extreme types) are fated to certain

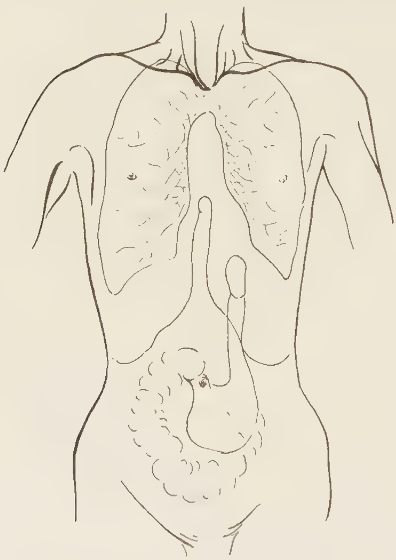


Fig. 86.—Physique of patient with asthenic habitus. (After Mills.)

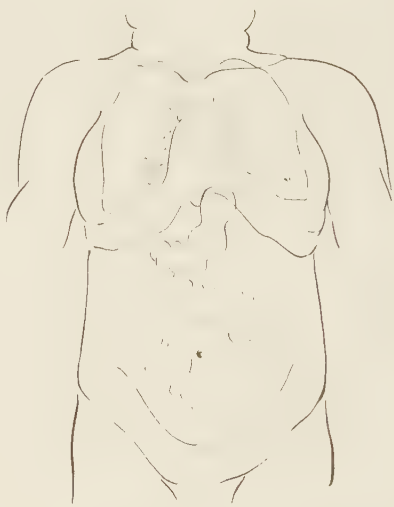


Fig. 87.—Physique of patient with hypersthenic habitus. (After Mills.)

pathologic tendencies. Furthermore in general and always allowing for particular variations and the danger of generalization, there is a different physiologic tonus at one end from the other. Down at the thin end are the pessimists—the people who advise you to put your money in the bank, and that a rainy day is coming; they like funerals, and divorces, and bankruptcies, and Chopin, and solitaire, and Dostoevski, and going to bed early, and Christina Rossetti, and cascara sagrada, and Schopenhauer, and the sterner forms of Presbyterianism. Up at the broad end are the optimists—they believe in having a good time while you are living because you will be a long time dead, and to them things are

looking up; they like births, and marriages, and stock dividends, and Mozart, and bridge and Dickens, and dropping over to see if the Hummels are awake, and Browning, and whisky sours, and William James, and the Episcopal church—(and their enemies are hypertension, and nephritis, and apoplexy, and gallstones and obesity and the pitiful age of fifty).

Let us note briefly some of the physical characters of the asthenic type. The body is lighter and longer than the normal. The bones are

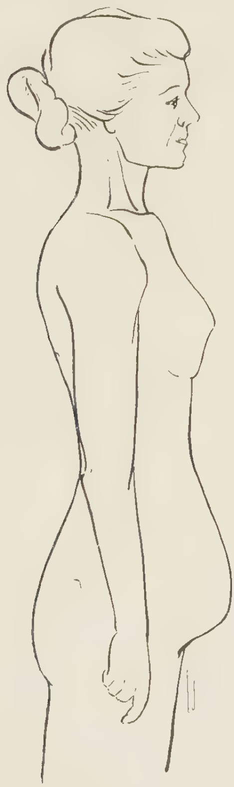


Fig. 88.—Lordotic type of visceroptotic habitus.

Fig. 89.—Most frequent type of asthenic or visceroptotic habitus—flat backed type.

thinner. The muscles are thinner, longer and weaker. The neck is long, and thorax long, the costal angle narrow; Stiller pointed out that the tenth rib usually is unattached. The trunk is long, the extremities usually long and thin. They do not tend to fatness. Their posture is characteristic, the shoulders are rounded with flaring scapulae, the chest is compressed, the spine is in most cases flattened with a loss of the normal lumbar lordosis, the pelvis is tipped forward. The abdomen is flabby, the highest point is below the navel when erect, and scaphoid

when recumbent. In some of the cases the lumbar lordosis is accentuated (the kangaroo type) the pelvis is tipped backward, and the abdomen "potted" from this posture.

The viscera suffer corresponding variations. The palate is usually high and tonsillar and adenoid tissue is abundant. The lungs are long and thin. The heart is narrow in its transverse diameter and drops from above downward. The diaphragm is low and mobile. The stomach is low, often the lower border is below the iliac crests, though the duodenum remains high. The small intestines and colon are also low in the abdomen. Kidney and liver may be floating. The mesenteries are long and lacking in fat.

The tonus of the gastrointestinal tract is decreased. The stomach may sag until the whole meal is in the lower pole. The intestinal mobility is reduced.

### III. Treatment of Congenital Universal Asthenia

Treatment must take into account the whole human being.

**1. Adjustment of Activities to Powers** is fundamental, important and difficult. Sometimes these people plan very extensive programs. In the middle of them they give way mentally and physically. Then they have a rest period—sometimes labelled "nervous prostration." Then they tackle another project, and the wheel makes another revolution. They do this because they do not themselves realize that they are not as strong as normal people. When they have pointed out to them the fact that they have only an 80 per cent efficiency, they are usually willing to make adjustments and plan their activities accordingly.

Of course there is always the danger of making the patient an invalid. Proper adjustment of the elements in the situation is up to the physician. As we have said above, the thing is difficult. Judgment and individualization are needed, and the technic is often wrong, and failure occurs.

**2. Rest.**—By rest is meant rest in bed or on a couch. Rest does a great deal for these patients. In the first place it stops the drag of the viscera upon the mesenteries, and stops the consequent nagging discomfort some of them have. Secondly, it relieves the strain on the thin weak muscles. Lastly it allows the accumulation of fat and connective tissues in muscles, mesenteries, etc., and thus strengthens the whole frame.

If one had absolute control over these patients and could enforce rest at any desired length, combined with hyperalimentation, the whole anatomy of their bodies could be changed. Once I had absolute control over such a group—during the war when I was in charge of the medical

department at a base hospital in a camp where fresh recruits were concentrated. At one time or another a particular type of recruit would be sent to the hospital by his regimental officer, to apply for an S.C.D. (Surgeon's Certificate of Disability). This particular type was the thin enteroptotic neurasthenic, or the congenital universal asthenic, the subject of this section. They were always reported unfit for military service by their officers. At those times when we had plenty of hospital space, and with the consent of the commanding officer, I refused discharge of these men and placed them in a ward under the supervision of a hardboiled sergeant. He made them keep to their beds day and night until they began to gain weight. Then they had gradual exercises, and especially abdominal exercises. In three months the anatomy of these men actually changed. Their weight increased, and with the deposit of fat in the mesentery and abdominal wall, their stomachs and intestines slowly rose out of their pelves and assumed the usual positions. Gastrointestinal tone was increased and constipation improved. In most instances they were returned to duty. Such autocratic power is seldom obtained in clinical practice. But it goes to show what can be done with these patients on a strict regime and a preliminary rest period of six weeks to three months. If this is not possible, as much rest as possible should be obtained early in the treatment and such adjustment as is necessary made later. The economic problem enters here. Dr. Bryant in his out-patient clinic dealing with patients, usually women, who have continuous daily work found that long rest periods were impossible and so made a compromise asking that the patient rest five minutes out of every half hour. Such short periods as that serve in an astonishing measure to renew the wells of energy and strength.

There is a rest period which is unremittingly imperative for these patients, that is the period after each meal. One of the chief mechanical disabilities which they have is the position of the sagging atonic stomach; when loaded with a meal, the lower pole hangs far below the pylorus. When the patient lies down the stomach is brought up so that it can much more easily empty itself. In the erect position the heavy meal sags the stomach greatly and not only gradually adds to the gastroptosis, but also breaks the muscular compensation of the stomach. (There is decompensation of the stomach as well as of the heart.) The stomach empties slowly, symptoms of heaviness and discomfort arise, anorexia comes on, and malnutrition results. Thus a vicious circle is established. All these things are helped by the recumbent posture.

**3. Hyperalimentation.**—An accumulation of fat always helps these people. They should receive extra nourishment until the weight is normal or above normal. Large heavy meals should, however, be replaced


Fig. 90.—Treatment of visceroptosis.

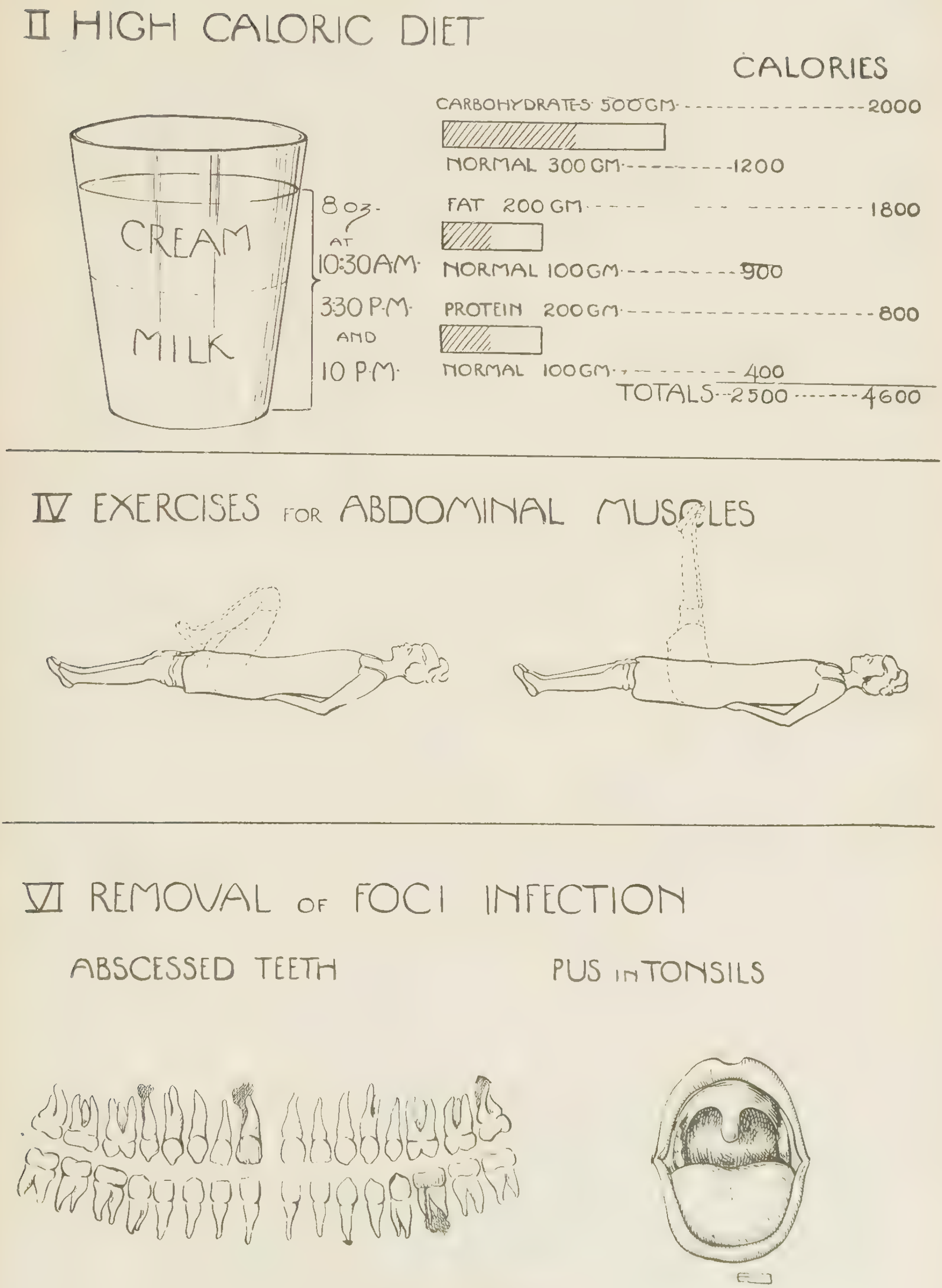



Fig. 90 (continued).

by smaller and more frequent meals. Wet meals with a great deal of water or fluid pull the stomach down too much, hence the food should be as dry as is compatible with palatability and the patient's taste. Foods of high caloric value and high vitamine content should be given between the regular meals—an eggnog, a glass of half milk, half cream, etc. A snack at bedtime is always advisable.

**4. Corset.**—See Part I for a description of the points in corset fitting. In the flatbacked type the corset should both support the abdominal muscles and support the lumbar region, besides throwing the shoulders back.

The corset should always be put on in the recumbent position so as to have the viscera high at the moment of adjustment.

**5. Exercises for Strengthening the Abdominal Muscles** should be given daily, increasing them in number as strength increases. They are described in Chapter X.

**6. Removal of Focal Infections.**—These patients seem especially prone to pyorrhea and poor teeth. Proper dental care is a very important part of the treatment.

All the methods mentioned are usually necessary in all the cases. The early part of the treatment can conveniently be carried out in a hospital and this is a highly intelligent method of achieving results. But the treatment can be carried out by any practitioner anywhere, and the results of such treatment are usually so gratifying as to make this one of the most satisfactory conditions with which we have to deal.

Surgery for visceroptosis is very particularly to be condemned. It is unnecessary, and usually a complete failure, the last state of the patient under surgery being worse by so many adhesions than the first state. Occasionally a kidney (with Dietl's crises) is better anchored. Some of the patients have gall bladder disease. Proper surgical treatment of this is a very excellent preliminary to the regular regimen.

The acquired form of visceroptosis, due to pregnancies, laparotomies or diastasis of the recti, may be treated less elaborately than the above outline indicates. A proper corset, abdominal exercises and suturing of the recti are sufficient.

## V. DISEASES OF THE PANCREAS

Medical treatment of diseases of the pancreas is not of particular value. Inasmuch as acute or chronic pancreatitis is usually a complication of gall bladder disease, particularly gallstones, the relief, if any is possible, comes from a surgical attack upon the gall bladder. It is conceivable that the attempt at relief of duodenal infection by the use

of salts, or the withdrawal of alcohol may be of some value, but it seems now well demonstrated that the infection is usually by way of gall ducts, irrespective of the duodenum. In the acute cases, the patient is almost always in very bad condition and the decision to operate requires courage, to say the least. It has been advised by an experienced surgeon that if the pulse is countable, operate. Free incision into the pancreas is more valuable as a temporary measure than cholecystectomy. In the chronic cases cholecystectomy or cholecystostomy is advisable, particularly if pain is a prominent feature. Pancreatic ferments and a low fat diet may be tried for physiologic reasons.

Cysts of the pancreas, pancreatic calculi and tumors are purely surgical.

## VI. DISEASES OF THE PERITONEUM

**Acute Peritonitis:** local or generalized.

Treatment is by:

1. Rest in bed in the sitting or Fowler position.
2. No cathartics or food by mouth.
3. Proctoclysis.
4. Morphine and atropine.
5. Drainage when and if safe.

**Tuberculous Peritonitis.**—Fifty per cent of the mild forms recover on a tuberculosis routine. For the cases with ascites surgery is indicated. Simple opening of the abdomen and evacuation of the fluid for some reason is curative in 75 per cent of cases; sometimes several such laparotomies have to be done.

**Ascites.**—Treatment in the milder forms consists of purging with saline cathartics, and the treatment of the cause.

Paracentesis abdominis is described in Part I.

## VII. DISEASES OF THE INTESTINES

### I. Intestinal Obstruction

**A. Organic.**—Diagnosis, at the earliest possible moment, is the only important duty of the medical man, in the presence of an intestinal obstruction. He may then advise with a surgeon. Operation, however, is not always the only possibility. In the case of children with intussusception or of strangulated hernias, it is always imperative, but in older people with volvulus or cases of the less easily classifiable forms of obstruction, *rest, time, morphine, gastric lavage, enemas, etc.,*

may be indicated, either because of the incomplete nature of the picture, or the bad condition of the patient.

*Forms of Nonsurgical Treatment for Intestinal Obstruction.*—1. Pushing massage of the abdomen used especially in volvulus. The patient is put in the knee-chest position. The physician stands at the side of the bed and places his hands underneath the patient on the abdomen, one above and one below the umbilicus. Pressure is exerted alternately by one hand and then the other. At each push the hand should move first towards the umbilicus and then away from it.

2. Injections of 50 per cent magnesium sulphate into the rectum. The magnesium sulphate has a relaxing action to the bowel when applied to the mucous membrane. The method has been very successful in the hands of Soper. He relates a case of an elderly woman who had an obstruction with great distention and pain. Operative intervention was considered. The patient had received several forms of medical treatment without relief. The magnesium sulphate enema repeated from time to time resulted in complete restoration of function. Later an adhesive periproctitis was found which caused partial obstruction, the acute stenosis probably being superimposed on this by spasm. In such conditions the magnesium sulphate enema is most effective.

3. Supernatant Oil Enema: A soft rubber tube is connected to a bottle containing olive oil—to the other side of the bottle is connected a tube in the course of which is placed a rubber bulb, the other ends of the tube being immersed in a bucket of warm water. The free tube is put into the rectum and gentle pressure made with the bulb. The oil floats on top of the water and precedes the water into the coils of the intestine. Aaron states that he seldom calls a surgeon before he has tried this method.

**b. Paralytic Ileus** almost invariably occurs as a result of trauma to the abdomen—laparotomy or labor. There is apparently a complete paralysis of the bowel with great distention and symptoms of shock. Haden and Orr have shown that the body chemistry of the condition runs a constant course—there is a marked *alkalosis* and an almost complete retention of chlorides. The chemical condition is similar to a lobar pneumonia. They have been able to keep animals with operatively formed obstruction alive and apparently comfortable for twenty-eight days by the administration of salt solution. Chlorides should by all means be furnished these patients in large amounts.

It is important to treat energetically the early stages of the condition—distention—with pituitrin hypodermically or oil of peppermint by mouth on sugar and by enemata; magnesium sulphate enemata will relieve a spasm of the lower bowel if present.

## II. Appendicitis

In the presence of an acute appendicitis or of any acute process in the abdomen, there is one lesson which I am sorry to say still needs to be reiterated:

DO NOT USE A CATHARTIC

Nearly anything else can be done with safety. This one thing, the most dangerous and murderous act that kind-hearted practitioners with the best intentions in the world do, is what is most frequently done. Every feeling of the patient seems to point to it. There has been no stool for a day or more—there is a feeling of tightness, of "lockedness" in the bowels, there is a stoppage, a lump there which if it can only be got to move will make everything all well—so the patient feels and so he expostulates. Looking back over the hundreds of young people I have seen in the agonies of general peritonitis and wondering why their doctors have heaped cathartics into them I believe that to be the explanation—all the symptoms make the patient feel and tell the doctor that "if only we could get something through" the trouble would be over. Frequently some member of the household has administered castor oil or salts, and the patient has vomited the dose. This is a clear piece of advice from Nature. But it is all too many times disregarded and cathartics continue to be given until one stays down.

Of course besides that, no food should be given.

Of course, also, a surgeon should be called as soon as possible, but in the vast majority of cases the medical attendant sees the case before the surgeon, and what he does not do is quite as important as what the surgeon does do. Furthermore, in the rural districts of the world, a patient may be far from a surgeon and there may be an interval between the time the diagnosis is made and the surgeon arrives. The passage of this interval is of little importance to the patient's safety (the customary advice as to the necessity of early operation to the contrary notwithstanding) provided no one is allowed to give the patient a cathartic, or food, or a large drink of water in the meantime. It is because I find this so often disregarded that I am so emphatic about it here.

The principle of all treatment before operation is to limit peristalsis—the old principle of rest. Anything introduced into the stomach will initiate peristalsis. Besides prohibiting cathartics and food, a gastric lavage may do good, as the stomach may have food remnants in it which keep up sporadic peristaltic movements; however, on the other hand, the struggle to insert the tube may do more harm than good. If the patient is thirsty, some cracked ice to chew, or small sips of water may

be given—never a large drink of water. If the diagnosis is made there is no objection to giving some morphine by hypodermic. It is often advised against on the ground that if pain is quieted the symptoms are masked and diagnosis obscured, but if the diagnosis has been made there is no reason why the patient should not have relief from pain.

### III. Diarrhea

**a. Due to amebae**—see Part I.

**b. Due to flagellate and other protozoa:**

1. The methods outlined in Part I for treatment of amebae and hookworm may be tried—ipecac, emetin by hypodermic, emetin-bismuth iodide by mouth, or thymol in capsules or by duodenal tube (in the case of giardia the flagellates were found almost entirely in the duodenum covering the mucosa; as these parasites are somewhat difficult to get rid of, such treatment should always be tried).

2. Neoarsphenamine is useful in many forms for giardia—0.6 gm. intravenously for three doses, five days apart.

3. Methylthionin hydrochloride (Merck's medicinal methylene blue, not the laboratory product which has traces of zinc) gr. 2 every three hours by mouth. Colonic flushes of $1/500$ strength aqueous solution of the drug may also be used.

4. Quinine by mouth or colonic flushings.

5. Giardia and possibly other parasites may become encysted in the appendix or gall bladder, reinfecting the bowel at intervals. In such cases removal of these organs should give relief.

**c. Due to achylia gastrica** or pernicious anemia—see treatment of achylia gastrica.

**d. Due to fecoliths**—a somewhat rare but very interesting condition —the formation of a concretion in the bowel lumen. The concretion usually is canalized so that feces pass only when the patient is in a certain position. If possible delivery of the fecolith should be effected by rectum. Laparotomies are curiously fatal in this condition.

**e. Toxic diarrheas**—endocrine diarrheas—diarrheas in the course of other chronic diseases—such as nephritis, cancer, diabetes, etc. This class is usually included in any classification on diarrheas, but is commonly not puzzling and requires no treatment.

**f. Due to chronic ulcerative colitis.** (a) *Medical treatment.*—1. Rest after meals. Rest in bed is not necessarily most beneficial, as Yeomans says some patients lose weight confined to bed, and the bowel movements are not materially lessened; some exercise is beneficial.

2. Nonresidue, mixed diet—eggs, mashed potatoes, soup, fruit juice. gelatin, ice cream, etc. See Diet No. 2 gastrointestinal diets, Chapter VI.

3. Colonic irrigation—2 per cent peroxide solution is best. Installations of warm olive oil, liquid petrolatum, bismuth, 1 or 2 per cent argyrol or orthoform or aqueous extract of Krameria may be tried.

4. Vaccine—Bargen has identified a diplostreptococcus as the specific cause of the disease. Autogenous vaccines cured 69 per cent of his cases.

5. Iodine—Tincture of iodine by mouth—10 drops three times a day—has resulted in surprising cures in some cases. Iodine by colonic irrigation is violently irritating.

(b) *Surgery:* Appendicostomy and colonic irrigation.

**g. Bacillary dysentery—usually acute.**

Treatment is by rest, diet, antiperistaltic drugs and serum as described in Chapter III.

**h. Due to Sprue.**—Tropical sprue has been found in some instances in North Carolina and Georgia. It is more common in the Philippines. It is characterized by sores in the mouth, a secondary anemia, and a somewhat characteristic diarrhea of large white stools, passed painlessly in the early part of the day.

The treatment is rather special. Drugs are useless. Rest in bed and a diet are the essentials. Strawberry diet only is said to be so effective as to be a diagnostic test. Milk diet only, 8 ounces every two hours, for nine feedings, slowly adding eggs, and fresh vegetables is used by Ashford. Beef diet and hot water is also used. Carbohydrates should be restricted "almost as in diabetes."

**i. Mucous colitis.** (a) *Treatment of the acute attack:*

1. Rest in bed.
2. Large doses of bromides.
3. Morphine and atropine if necessary after flushing out the colon.
4. Hot applications to abdomen.
5. Broth and soup diet.
6. After the spastic condition has been relieved by these measures, castor oil or oil enema.

b. *Treatment of the chronic condition.* Mucous colitis is not a clinical entity; there are many varieties of it. Often it is a manifestation of ptosis. Sometimes an infection of the gut wall or its tributaries may be an apparent cause. Each case must be individualized. I have never been much impressed with the value of the distinction made by some writers, of a fermentative form and a putrefactive form, the first due to poor digestion of starches, the second to poor digestion of proteins. Nor do I believe that, although the patients may be neurasthenic in their psyche, a neurogenic origin can be successfully upheld.

The symptoms are notably likely to recur. But I can echo the opinion of Bastedo that treatment is of considerable avail, and I repudiate with him the pessimism of such statements as he quotes from a medical speaker that "the prognosis is hopeless, and the treatment nil."

The elements of treatment are these:

1. Directed at the constipation and ptosis. Often attacks are precipitated by fecal accumulations and stasis. The patients may have to be hung over the side of the bed, and oil pumped into the colon to soften up the masses of feces. Too much apprehension and unnecessary use of cathartics or enemata are, however, equally as irritating as stasis. A weekly dose of castor oil is a good routine for some patients.
2. Diet: The bland, nonresidue-containing gastrointestinal diet No. 2 in Chapter VI works well in all cases, in my experience.
3. Colonic lavage—with tap water, salt solution or soap suds weekly, twice weekly, etc.
4. Exercise, rest, work, play in proper proportions. Observation of rules of hygiene; never nervously fatigued. Five minutes' rest on a lounge out of every hour.
5. Coffee, tea, tobacco limited or deleted.
6. Surgery for rectal diseases.

j. **Diarrhea in infants** is nearly always due to food fermentation or putrefaction or to improper feeding. In its treatment two factors are important:

1. To clear the bowel. The best means for this is castor oil.
2. To get fluids into the circulation. Hypodermics of 5-10 c.c. of salt solution or tap water will do this if stomach and rectum reject all fluid.

## IV. Constipation

The average time at which food should reach the successive parts of the large intestine in normal persons is as follows:

At the cecum in 4 to 6 hours.
At the hepatic flexure in 6 to 8 hours.
At the splenic flexure in 9 to 19 hours.
At the sigmoid in 12 to 16 hours.
In the rectosigmoid junction in 18 to 24 hours.
Complete evacuation of an entire meal occurs in about 33 hours.

In constipation the delay in progress of food may occur at any point in the large intestine. It never occurs in the small intestine, though I think there may be such a thing as ileocecal valve regurgitation. Aside from that constipation never occurs in the small intestine. In the large majority of cases the delay occurs in the cecum or in the sigmoid.

The physiology of defecation should be understood. The rectosigmoid junction is a point in the intestinal canal similar to the cardia, the pylorus, and the ileocecal valve. It has a ring of circular muscle fibers and a valve-like projection into the lumen. The character of the mucosa is different above and below it. Its nerve supply may be special. It is the narrowest part of the large intestine. It acts as a valve and feces

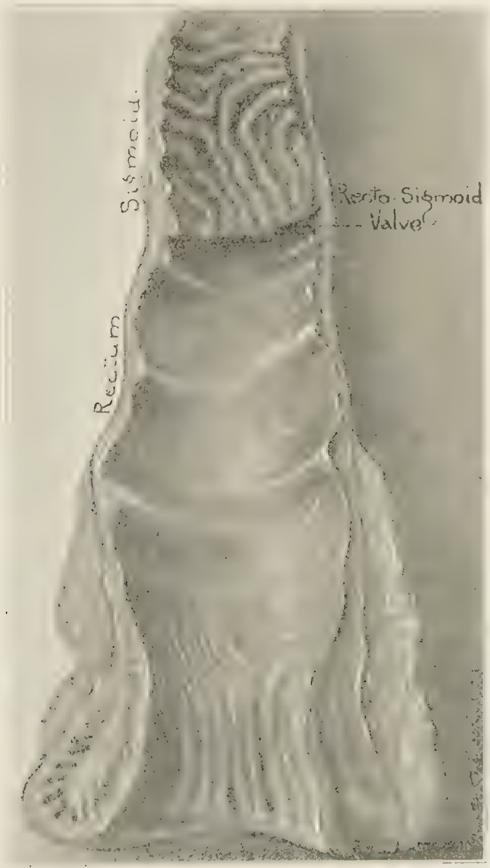



Fig. 91.—Rectum, sigmoid, and rectosigmoid apparatus. (After W. J. Mayo.)

do not enter the rectum except just prior to defecation. In normal individuals the rectum is empty of feces except at the time of defecation. In normal people, daily, usually in the morning after the stimulus of arising, and the peristalsis initiated by breakfast, peristalsis begins in the colon; the rectosigmoid valve then relaxes, and the fecal column enters the rectum. The presence of feces in the rectum excites the "muscle sense reflex" and the call to stool is sent to the higher centers.

At stool the sphincter ani relaxes and by the law of contrary innervation the rectum contracts expelling its contents.

This, however, is not all. Normally the act of defecation consists of two stages. After the first fecal mass has been expelled, the rectum expands, the rectosigmoid valve relaxes again and the remainder of the column of feces from the descending colon enters the rectum, and in a similar manner to the first is expelled. These two stages of the act may be practically continuous and it goes unnoticed that two stages have occurred. With a complete effective defecation the colon at least from the splenic flexure down should be entirely emptied.

**Classification of Constipation.**—No classification is entirely satisfactory. The following one makes no attempt at either a definite anatomic or etiologic division but presents a clinical grouping which I believe is of practical value.

1. Constipation in which the delay is largely in the cecum and ascending colon.
2. Constipation in which the delay is largely in the sigmoid or rectum or both. (The "dyschezia" of Hurst.)
3. Mixed forms.

Any of these may be due to:

1. Atony of the bowel. Atonic constipation. Simple uncomplicated constipation.
2. Infection, ulceration, polyp formation of the bowel wall particularly at the anus, at the rectosigmoid junction and at the ileocecal valve. Infections of the rectal and sigmoid mucosa can occur from excessive use of enemata. Often an infected enema tip will introduce pus organisms into the bowel which lodge in the mucosa. This feature must be inquired into during the taking of the history.
3. Excessive use of cathartics causes spastic spots, infections and minute ulcerations in the descending colon, and especially the rectosigmoid junction. They may cause ulcerations elsewhere but they cannot be seen with the sigmoidoscope.
4. Visceroptosis. Asthenia congenita universalis. Bad physique and habitus.
5. Bad habits of going to stool. Disregarding the "muscle sense reflex" when the fecal mass passes the rectosigmoid valve and enters the rectum. Postponement of defecation at this time, due to lack of time by young people going to school, or people going to business, sometimes from false modesty, will result in a dulling of the sense of necessity and the accumulation of the feces in the rectum and sigmoid.
6. Unsuitable diet.

*Study of a case of constipation* preparatory to determining a course of treatment is very important. It includes:

1. A careful history.

2. A detailed account of habits as to meals and the taking of cathartics, and enemata.

3. X-ray study of a barium meal (possibly a barium enema x-ray study).

4. An examination of the rectum, rectosigmoid junction and sigmoid with the sigmoidoscope.

**Treatment of Constipation.**—Depending on the type present some combination of the following means can be used:

1. *Breaking of old habits,* i.e., giving up the taking of irritating cathartics and the disregard of calls to stool.

2. *The establishment of regular habits of going to stool,* of exercise, of the time of eating meals, etc. It has become traditional for medical men in written and spoken argument to say that the patient must go to the toilet at a regular time every day and stay there until a stool is passed. This has apparently always seemed a very sensible thing to say, and I hate to break with tradition, but I do not believe it. I submit that it never works. The men who are most emphatic in the iteration of it simply repeat it. Physicians have said the same thing since the days of Galen—and they are very careful not to tabulate any cases in which it has worked. On the contrary, I can produce affidavits from a score of people who have tried it faithfully and unsuccessfully. The very attitude—mental and physical—of expectancy seems to inhibit every millimeter of the large intestine. It does not give even a quiver.

3. *Diet.*—Regularity of meals is important. A glass of water before breakfast may initiate peristalsis sufficiently to cause a postprandial daily movement. Foods with residue (bran) and certain foods with a slightly laxative effect, honey, molasses, etc., are indicated in the diet list for constipation in Chapter VI.

4. *Surgery* directed towards clearing up any rectal trouble which might cause spasm higher up, or which might inhibit defecation on account of its painful character. When it helps at all surgery helps marvellously.

5. *Massage of the Abdomen.*—The cannonball massage is the type of all of these—a heavy ball rolled over the abdomen in the direction of the peristaltic progression—from the lower right hand quadrant to the upper right hand quadrant, across to the upper left hand quadrant, to the lower left hand quadrant—repeating over and over. Kneading the

abdomen in this direction has the same action. It may be done by the patient himself in bed before arising.

6. *Exercise in General.*—Exercises to strengthen the abdominal muscles and general enteroptotic regimen when indicated.

7. *Drugs.*—The only cathartics permissible are cascara, liquid petrolatum, agar-agar and bran.

8. *Enemata.*—The oil enema, using about 8 ounces of olive oil or cottonseed oil, injecting this slowly at night with Robert's enemator or a Goodyear hard rubber syringe No. 65 with a curved tip and leaving it all night, is valuable in the atonic forms of lower colon constipation, dyschezia, and even some spastic conditions at the rectosigmoid junction.

9. *Bacillus Acidophilus.*—The implantation of this organism in the intestine has given some remarkable results in the hands of many clinicians. For instance Kapeloff has reported a series of cases showing the following results:

| | BEFORE TREATMENT | | AFTER B. ACIDOPHILUS | |
|---|---|---|---|---|
| CASE | NO. DEFECATIONS | NO. DAYS | NO. DEFECATIONS | NO. DAYS |
| 1 | 2 | 14 | 19 | 23 |
| 3 | 1 | 34 | 46 | 59 |
| 4 | 8 | 31 | 20 | 55 |
| 5 | 1 | 7 | 12 | 24 |

Stopping the daily use of B. acidophilus milk after the improvement has continued for six months.

The organism must be given in milk and at least 1000 c.c. of milk is given daily, containing 200,000,000 organisms to each c.c. This amount of milk must be given for at least a month or six weeks. The stools should be studied and plated to see that the flora has changed before the treatment can be stopped. Under no circumstances should the tablets put up by manufacturers be used. The organism grows well in lactose and a good preparation for treatment is for the patient to eat a good quantity of lactose daily for a week.

C. C. Bass gives the following instructions for the preparation of the milk:

*Care of stock culture:* The stock culture should be kept up by frequent transplanting (preferably every day) to autoclaved milk in regular culture tubes. Relatively large amounts of inoculum must be transferred. Small pipettes drawn from glass tubing of proper size plugged with cotton before sterilizing and fitted with a rubber bulb just before using are convenient for this purpose. The outside of the pipette can be sterilized just before using by passing through a flame.

*Preparation of inoculum for routine production of acidophilus milk:* Bottles of skimmed milk, plugged with cotton, are sterilized in the auto-

clave for 15 minutes at 15 pounds pressure. A bottle should contain as much milk as will be required to inoculate all the milk to be inoculated on a given day.

"The first bottle of inoculum is prepared by inoculating one of these bottles of milk from the stock pure culture and incubating for 24 hours or longer, until coagulation takes place. This should be broken up by shaking before using. Subsequently, the bottle of inoculum for the next day may be inoculated by pouring some of the day's inoculum into another bottle of autoclaved milk, etc.

"*Preparing milk to be used in routine production of acidophilus milk:* Round tincture bottles with cork stoppers having a capacity of 20 ounces ("English quarts") are most convenient for making 500 c.c. quantities. This allows extra space for shaking. They should be dry sterilized.

"Milk (skimmed or whole) should be brought to boiling temperature for a few minutes in a double boiler and poured while hot into the

Fig. 92.—Goodyear hard rubber syringe No. 65, with curved tip, for giving oil enema at bedtime in dyschezia.

bottles, about 500 c.c. to the bottle. After cooling down to about 37° C. they should be inoculated.

"*Inoculation:* Pour 10 to 15 c.c. of inoculum into each bottle, replace the stopper, shake and put in the incubator at 37° C. for about 24 hours. Remove, shake thoroughly and place in the ice box. This is 'acidophilus milk' and is ready for use. If kept cold, it is good for at least two or three days.

"*Administration:* Information available at present indicates that taking 1000 c.c. or more of acidophilus milk daily results in almost complete transformation of the intestinal flora, in most individuals at least, within a period of from one to two weeks. Much smaller quantities are far less effective. Less than 500 c.c. daily probably has little transforming effect. Ideally, a portion of the daily quantity should be drunk along with each meal. Unfortunately, the acidophilus flora give way to the usual mixed flora within a week or two after the acidophilus milk is discontinued."

10. *Local Treatment through the Sigmoidoscope* is a very valuable method, introduced so far as I know by Dr. Horace W. Soper of St. Louis. Ulceration and infection of the lower part of the bowel should be treated with a powder blown into the bowel through the sigmoidoscope with a powder blower. This powder consists of equal parts bismuth subcarbonate and calomel, is nonirritant and antiseptic. After introduction it clings closely to the mucous membrane "like the frosting on a cake."

For the spastic conditions the introduction of 50 per cent magnesium sulphate solution will relieve spasm and be of great benefit. The solution is introduced through a catheter and the patient instructed to lie on the side fifteen minutes after it is introduced. These treatments are given daily or every other day until the spasm relaxes. This treatment gives considerable temporary relief although the spastic conditions are very liable to recurrence.

For photograph of the powder blower and the technic of sigmoidoscopy see Chapter XIV. Under local treatment the use of rectal dilators should be included. Part of the benefit of the sigmoidoscope may be the dilatation of the sphincter. This dilatation certainly stimulates the movement of the entire colon, just as the dilatation of the rectum with an enema stimulates peristalsis in the ascending colon. Sphincter dilatation has been used for years. John Burne, in a book on constipation published in 1840, wrote:

"The bougie may, I think, be had recourse to with advantage more frequently than is customary in the treatment of habitual constipation, and some of its consequences. A bougie of moderate size introduced into the rectum and allowed to remain some minutes has been found on withdrawal to be followed by an action of the bowels. Employed for this purpose, it should be introduced 8 or 9 inches, so as to arrive at and dilate the upper part of the rectum, which, according to O'Beirne, is always contracted and in a state of spasm. The most convenient time for its employment is before arising in the morning, and its use should be persevered in daily by the patient himself."

11. *Psychotherapy.*—The explanation to the patient of the physiology of defecation, so that he understands the advantage of answering the call to stool, and the importance of obtaining a complete evacuation which will empty the colon to the splenic flexure, is what is meant by psychotherapy.

There is another aspect of the matter, of which I personally am thoroughly convinced, but which is diametrically contrary to the fixed ideas of most of the human race, including those members of it who are practicing medicine--I refer to the harmlessness of constipation. I am

convinced, as I say, that it is practically harmless. The only organic conditions it ever causes are a minute fraction of cases of chronic arthritis, possibly interstitial mastitis, and colon bacillus pyelitis. The first two named are of great rarity, and the evidence for their etiology in constipation is far from complete. Constipation is supposed to be a dread disease but how often in general consultation practice do we find complications of it? Practically never. Yet patients frequently tell us that constipation has taken ten years off their lives. Or that constipation has made them melancholy and their lives a tragedy. It isn't the constipation which does it, but their opinion about constipation. If these patients are convinced that constipation itself is not harmful, and that there is no law of Nature which decrees that every human being must have one defecation per day, and that if they will wait without cathartics until the call to stool comes, they find in very many instances that they have a two or three day defecation cycle and that in the meantime they are perfectly healthy.

On what other basis can we explain the claims, which I believe are among the most reliable which they make, of the psychic healing cults—Christian Science, the recent M. Coue, as well as such orthodox persons as M. DuBois—that under mental treatment alone constipation is entirely cured? I believe the explanation lies in the removal of cathartics, the relief of pathologic worry, and the reestablishment of the individual's regular cycle.

*Resume and Comment.*—Of my own cases of constipation, 30 per cent when carefully studied had no constipation at all. In other words on studying a barium meal and observing it daily, with care that no cathartic was used during the observation period, the barium meal completely disappeared on the second day after its ingestion. The patients had been the objectives of cathartics and morbid fears for years.

Simple atonic constipation occurred in about 50 per cent of my series. By simple methods—reassurance, massage of the abdomen when the patient is in the defecation position; making pressure under the ribs; occasional dilatation of the sphincter; drinking a glass of water on arising; fruit and vegetable and bran diet; in some cases the use of cascara or liquid petrolatum or agar-agar—colonic function can be restored in a few months.

Dyschezia was present in about 3 per cent of my cases. Treatment by enemata was not brilliant.

In a little over 5 per cent rectal or anal disease remediable by surgery occurred.

In about 15 per cent of cases a spastic or inflammatory condition of the rectum, rectosigmoid junction or sigmoid occurred. Local treatments have been very satisfactory.

The methods most useful in my experience in the order named were:

1. Stopping the use of cathartics.
2. Psychotherapy—explanation, encouragement, allayment of fears and obsessions. Advising the patient to await the call to stool and obey it.
3. Massage of the abdomen.
4. Cascara sagrada, taken daily, 5 minims after meals, or 30 minims at bedtime.
5. Liquid petrolatum or agar-agar, or bran.
6. Local treatment to rectum, sigmoid and rectosigmoid junction.
7. Surgery to rectum and anus.

In my hands diet, general exercise, going to the toilet and waiting for defecation, and enemata have been failures. I have not used bacillus acidophilus long enough to feel prepared to give an opinion on it.

### V. Sigmoid Diverticulitis

Massive doses of barium or bismuth, as suggested by Dudley Roberts, is the most satisfactory medical treatment. The well-known fact that after an x-ray examination these patients are better is a hint of the value of this method and gives an idea of dosage. Roberts says, "Something must fill these pockets and a nontoxic, unabsorbable, bland substance would seem to be preferable to putrefactive feces."

Surgery must not be lightheartedly recommended. These cases are for the Athos not the D'Artagnan of the surgical field.

Cathartics and enemas should be avoided. Agar-agar in large dosage may be helpful.

During the acute attack—rest in bed, no cathartic, Preissnitz bandage to abdomen or hot water bag.

## DISEASES OF THE LIVER, GALL BLADDER, AND BILIARY PASSAGES

The liver and bile passages are subject to many interesting pathologic processes, but from the standpoint of treatment they reduce themselves to a very few conditions and methods of treatment. I shall not, therefore, detail every disease of these organs, but will outline the treatment for the most common of them. The methods used in the treatment of these commoner diseases are those applied to the rare forms.

### I. Jaundice

Jaundice may be due to any of the following conditions:

1. Catarrhal inflammation of the bile ducts. Catarrhal jaundice.
2. Obstruction of the common ducts by stones. Obstructive jaundice.
3. Degeneration of the liver parenchyma by various poisons, commonest of which are chloroform, arsphenamine, phosphorus, nitro- and amido- compounds of the benzene group.
4. Acute yellow atrophy of the liver.
5. Passive congestion of the liver.
6. Cirrhosis of the liver, all forms.
7. Syphilis of the liver.
8. In the newborn.
9. Cancer of the head of the pancreas.

Acute catarrhal jaundice may be taken as the type of all these forms for treatment. The object of treatment will be to rid the bile passages of the mild infection of which they are the seat, and possibly to overcome the obstruction of the common duct at the point of its entrance into the intestine. The older writers ascribe the jaundice entirely to inflammatory swelling at the opening of the common duct and to flakes of mucus causing this obstruction. Their efforts were largely directed towards overcoming the duodenitis. Whether this view of the pathology is too simple or not it remains a fact that most of our treatment is based on the tacit assumption that it is the true explanation. The methods of treatment are as follows:

**a. Use of Saline Cathartics.**—Magnesium sulphate and sodium phosphate dissolved in water and taken in large quantities on an empty stomach are designed to rid the duodenum of mucus and allay the inflammatory edema around the bile passages.

**b. Diet.**—Elimination of fat from the diet is valuable because bile is needed in the digestion of the fats in the small intestine. Easily digested foods such as milk, albumin water, junket and custards are permitted. A fat-free diet will be found among the diet lists in Chapter VI.

**c. Duodenal Biliary Drainage.**—The method of Lyon as described in Chapter XIII of introducing a duodenal tube and lavaging the duodenum with 50 per cent magnesium sulphate solution, is more valuable in catarrhal jaundice than in any other disease in which it is used. The treatment usually serves to clear up a jaundice of this kind in a week or ten days while under ordinary circumstances it runs a period of six to ten weeks. The duodenal tube should be inserted every other day for a time, until the jaundice begins to clear up and a large amount of bile is drained through the tube at each introduction. At the first one

or two sittings it has been my experience that very little bile is obtained through the tube after the introduction of the magnesium sulphate solution. Afterwards, however, bile will begin to flow freely.

### II. Cirrhosis of the Liver

The only common form of cirrhosis of the liver is portal cirrhosis, otherwise called atropic cirrhosis, or gin-drinker's liver, alcoholic cirrhosis, or Laennec's cirrhosis. Biliary cirrhosis, or hypertrophic cirrhosis, or Hanot's cirrhosis is a rare disease the exact classification of which is somewhat difficult. It is not improbably identical with hemolytic familial jaundice. Its treatment is therefore probably by splenectomy or if not is entirely symptomatic.

The treatment of portal cirrhosis consists of three elements:

**a. Removal of the Cause.**—The cause is invariably alcohol. While there may be some academic discussion as to whether alcohol is an etiologic factor in all cases, the cases in which it is not are so rare as to be negligible. Extraordinary precautions and acumen may have to be displayed even in hospitals and other institutions against the patients' obtaining alcoholic beverages. They are frequently slipped into the patient's bedroom by kind-hearted friends and relatives and hid in the bed, mattress, etc. I once removed six empty gin bottles from the mattress of a female patient suffering from cirrhosis of the liver. In the early stages of the disease even the slightest amount of alcohol serves to keep the process progressive.

**b. Drainage of Ascites** is done by paracentesis abdominis, the technic of which is described in Chapter XIII. The frequency of tapping is governed by the necessities of the case. The use of novasurol and ammonium chloride (see chapter on Drugs) will obviate the necessity for frequent tappings in most cases.

**c.** To restore the functional ability of the liver Rowntree advises the unrestricted use of sugar, glucose and sodium chloride by mouth or intravenously.

**d. Establishment of Collateral Circulation by Surgical Means.**—The operation of Talma consists in suturing the omentum to a raw place in the liver surface. This is intended to produce anastomosis of the portal and general venous circulation. The results are described as very good, but it must be noted that the primary mortality is about 33 per cent. The most favorable cases are those in which the ascites is the prominent symptom and heart and renal degenerations are not present.

Medicinal methods of treatment of cirrhosis are the use of calomel in large doses, as much as three grains four times a day, and the use of

iodide of potash in large doses. Bitartrate of potash has the recommendation of so eminent a clinician as Eichhorst. It is given in a syrupy menstruum in the dose of 30 grains four times a day. It is designed to relieve the ascites and prevent tapping and does so probably by its diuretic properties.

### III. Abscess of the Liver

Abscess of the liver may be due to amebic disease, to an ecchinococcus cyst of the liver or to metastatic infections from the appendix and other organs. The treatment is always surgical except that, in the case of amebic abscess, some authors claim cure entirely by emetine injections.

### IV. Cholecystitis and Cholelithiasis

**a. Treatment of the Acute Attack.**—The treatment of an acute attack of gall bladder colic need not be so strenuous as the treatment of an acute renal colic. The use of a Preissnitz bandage, or hot water bag may be sufficient to give relief. In the severe forms morphine and atropine hypodermically, will, however, be necessary.

**b. Treatment of the Chronic Condition.**—While the condition is always potentially surgical in actual practice, many cases must be treated upon a medical basis. The patient often refuses operation, or is in poor physical condition on account of the heart or kidneys to undergo operation. Medical treatment is by no means a complete failure, as I have known patients to remain comfortable for fifteen or twenty years using no other means. The patient should understand however that the treatment is merely palliative and that nothing but surgery is designed to afford a complete cure.

Sodium phosphate has long been considered of particular value in the treatment of mild gall bladder infections. Whether it is better than any other salt, I am not prepared to say; however, I always use it in these cases in preference to other salts and order the patient to take a tablespoonful of the crystals dissolved in a glass of hot water on arising and sipped slowly during the period of dressing before breakfast. Such famous spas as Carlsbad and Vichy were famous for their treatment of gall bladder troubles largely on account of some such routine.

The diet must be bland and may be somewhat like the diet for hyperacidity and ambulatory ulcer cases as given in Chapter VI. The content of fat in these diets is somewhat too high. Rich and fattening foods should be avoided. The patient should be instructed to take regular daily exercise, a certain part of it in the open air. As these patients are

usually obese, elderly, and plethoric, the exercise must be mild. Over-indulgence in alcohol, tobacco, spices and condiments must be prohibited.

The hyperacidity which some of these patients have may be treated by the use of sodium bicarbonate and magnesium oxide, and I have found that the addition of charcoal to this mixture ⅓ of the entire amount is helpful in those frequent cases who complain of gas, flatulence, and tympanites.

The use of the Lyon method of duodenal biliary drainage is one which will admit of some debate at the present time. The technic of the introduction of the tube and the magnesium sulphate solution will be found in Part I.

Lyon's claims were: (1) that the magnesium sulphate solution relaxed the sphincter muscle of Odii around the opening of the common duct, and by the law of contrary innervation caused the gall bladder to contract, and thus drain itself; (2) that there could be distinguished three sorts of bile as they were recovered from the tube—A, B, and C bile. The first is a light yellowish bile, mixed with duodenal contents, coming from the common duct; the second, B, bile, which appears in from 10 to 30 minutes is darker, heavier, and more viscid, coming from the gall bladder itself; the third, C, and a subvariety D, bile is golden yellow, clear, less syrupy and comes from the liver, that is, the biliary capillaries. Clinically Lyon claimed that the treatment would drain the gall bladder and thus relieve cholecystitis, that a culture of B bile would result in the manifestation of the organisms which caused the inflammatory condition and a vaccine of them could be used with benefit. He also reported cases of removal of the gall bladder in which no relief of symptoms occurred, which were helped by this method postoperatively.

Other clinicians have shown that these claims are too extravagant. Bassler, Luckett and Lutz observed patients during laparotomy with the gall bladder directly under observation. A duodenal tube had been introduced before operation and the magnesium sulphate was introduced after the abdomen had been opened. Bile drained through the tube, corresponding to A, B and C bile, but the gall bladder did not contract and its contained bile did not leave the gall bladder. At the same time there was no biliary obstruction because the gall bladder could be compressed and readily emptied. Other observers have furnished complementary information. It is now generally agreed that B bile does not come from the gall bladder but from the liver. Furthermore, Dunn has shown that magnesium sulphate by mouth will drain bile from the liver. Other substances introduced through the tube also cause the

flow of bile. The bacteriologic integrity of Lyon's work has always been palpably doubtful.

The discussion has been carried on not without some hints of acrimony. There is no doubt that Lyon cannot maintain his early extreme position. It is not certain that the position of his most violent critics is not equally extreme and unfair. Summarizing the matter in the light of my own experience, I believe that the theoretical considerations advanced by Lyon are largely untenable—the gall bladder does not contract, the various changes in the appearance of the bile are not due to the portions of the biliary tract from which it came. Clinically the method is very useful in catarrhal jaundice. It is of no value in actual stone formation. In cholecystitis or cholangitis (after cholecystectomy) it provides or helps to provide symptomatic relief in about half the cases. It is possible that the drainage of the bile from the liver going past the cystic duct helps to empty the gall bladder also and thus provides some of the relief.

## References

### *Ulcer of the Stomach and Duodenum*

Crohn and Reiss: Am. Jour. Med. Sc., January, 1920, clix, 70.
Hamburger: Am. Jour. Med. Sc., February, 1918, clv, 204.
Joslin: Jour. Am. Med. Assn., November 21, 1914, lxiii, No. 21.
Leube: Von Ziemssen's Handbuch de spec. Path. und Ther., 1876, vii, 192.
Lockwood: Diseases of the Stomach, Philadelphia, 1913, Lea and Febiger.
Lockwood: Jour. Am. Med. Assn., April 1, 1911, lvi, No. 13.
Martin: Parenteral Injections Purified Milk in Peptic Ulcer, Arch. Int. Med., March, 1929, xl, No. 3.
Moynihan: Surg., Gynec. and Obst., June, 1907.
Sippy: Jour. Am. Med. Assn., May 15, 1915, lxiv, No. 20.
Sippy: Oxford Medicine, 1921.
Smithies: Jour. Am. Med. Assn., June 5, 1920, lxxiv, No. 23.

### *Visceroptosis*

Bryant: Visceroptosis: Normal Incidence, Jour. Am. Med. Assn., October 29, 1921, lxxvii, No. 18.
Glenard: Lyon Med., 1885, xlviii, 492.
Goldthwaite: An Anatomic and Mechanistic Conception of Disease, Boston Med. and Surg. Jour., June 17, 1915, clxxii, No. 24.
Goldthwaite: The Relation of Posture to Human Efficiency, Proc. Am. Orthopedic Assn., 1909.
Mills: The Relation of Bodily Habitus to Visceral Form, Am. Jour. Roentgen., April, 1917, iv, No. 4.
Smith, R. R.: Enteroptosis, Jour. Am. Med. Assn., November 26, 1910, lv, No. 22.
Stiller: Ueber Enteroptose im Lichte eines neuen Stigma Neurasthenicum, Arch. f. Verdauungskr., Berl., 1896, No. 285.

### *Constipation*

Hurst: Constipation and Allied Intestinal Disorders, Oxford Press, 1909, et seq.
Mayo, W. J.: A Study of the Rectosigmoid, Surg., Gynec. and Obst., December, 1917.
Schwarz: München. med. Wchnschr., 1912, xxviii.

Skinner, E. H.: X-ray Investigation of Habitual Constipation, Surg., Gynec. and Obst., October, 1913.
Soper, H. W.: A Physiologic Basis for the Treatment of Chronic Constipation, Southern Med. Jour., February, 1921, xiv, No. 2.

### *Ulcerative Colitis*

Bargen: Changing Conceptions of Chronic Ulcerative Colitis, Jour. Am. Med. Assn., Oct. 20, 1928, xci, No. 16.

### *Sigmoid Diverticulitis*

Roberts, Dudley: Recognition and Treatment of Intestinal Diverticula, Surg., Gynec. and Obst., 1918, xxvi, 211.

### *Jaundice*

Bassler, Luckett and Lutz: Some Experiences with the Meltzer-Lyon Method of Draining the Biliary System, Am. Jour. Med. Sc., November, 1921, clxii, No. 5.
Lyon: Biliary Tract Disease, Am. Jour. Med. Sc., January and February, 1922, clxii, Nos. 1 and 2.
Lyon: Can the Gall Bladder, Biliary Ducts, and Liver be Medically Drained? Am. Jour. Med. Sc., October, 1920, clx, No. 4.
Lyon: The Treatment of Catarrhal Jaundice by a Rational, Direct and Effective Method, Am. Jour. Med. Sc., April, 1920, clix, No. 4.

## CHAPTER XXII

## DISEASES OF THE DUCTLESS GLANDS

### I. THE THYROID GLAND

#### a. Enlargement of the Thyroid Gland—Goiter

Goiter may vary from the large hard colloid goiters, to the slight enlargement which occurs in girls at the onset of puberty and in women during pregnancy and occasionally at the menstrual period. Every possible variation occurs between the two extremes, and there is as well the possibility anywhere along the line of the development of toxic symptoms.

The only effective treatment of the colloid goiter is surgical removal. It should be urged upon all patients, I believe, because of its safety in careful hands, and the possibility of the degeneration of the nontoxic into toxic forms.

**The Prevention of Simple Goiter.**—One of the most remarkable and valuable developments of modern medicine has been the demonstration, by Marine and Kimball of Cleveland, of the prevention of goiter by the administration of iodides.

Like most effective therapeutic measures, the method is simplicity itself. Sodium iodide is the salt used: 0.2 gm. (3 grains) are given daily for ten consecutive days, twice a year, spring and fall. In other words 2 gm. (30 grains) twice a year is sufficient to prevent the development of goiter in goitrous districts, and to inhibit the growth of thyroids already slightly enlarged.

The effectiveness of the method has been tested by careful examinations of large groups of school children in the goitrous region around Cleveland. In Akron, Ohio, 2190 children were given the sodium iodide and compared with 2305 children who did not receive it. Of those children who were normal, at the time observation was begun, 99.8 per cent of those who received treatment, showed no increase of the thyroid a year later; and 27 per cent of those who did not receive treatment showed thyroid enlargement. Of those children with slightly enlarged thyroids, at the time of beginning observation, 57.8 per cent who took treatment, showed a decrease a year later; 13.9 per cent of those who did not take treatment showed a decrease. Of those children with moderately enlarged thyroids, 79.7 per cent decreased under treatment,

and none increased, while 12.4 per cent of the controls showed decrease and 23.6 per cent of the controls showed increase.

The method has been extended to the treatment not only of school children but to large groups of women in factories, etc. In Switzerland, where 100 per cent of the children are goitrous, Professor Klinger has had such remarkable results that the administration of iodides to children in school may be made a compulsory public health measure.

The rationale of the treatment depends upon the well-known fact that iodide is a constituent of the normal thyroid gland. The actual amount varies from 0.1 per cent to 0.5 per cent, and it has been shown that if the store of iodine in the gland substance falls below 0.1 per cent active hypertrophic and hyperplastic changes in the thyroid begin.

*Iodine is taken up by the thyroid when given by mouth, by inhalation or by external application.*

McClendon and Williams have shown, by analyzing samples of water from all over the United States, that the regions where goiter is endemic correspond exactly to the regions where the percentage of iodine in the drinking water is lowest. In Washington and Oregon, and around the Great Lakes where goiter is 15 to 30 per thousand of population, the water contains 0.5 parts iodine per billion. Along the Atlantic seaboard and in the Southern states where goiter occurs at the rate of 1 per thousand population, the proportion of iodine in the water is 3 to 20 per billion parts.

Fear that the administration of iodides will cause exophthalmic goiter has been shown to be groundless in Marine and Kimball's extensive series of cases.

### b. Intoxication from the Thyroid Gland—Exophthalmic Goiter—Toxic Adenoma

It is debatable whether these states are due to an increase in the amount of thyroid secretion absorbed, or to a toxic product formed by the thyroid unlike any product formed in health—in other words whether they are due to a hyperfunction or a dysfunction. The cases range from the mild thyrotoxicosis (mostly in women) with or without slight thyroid enlargement, with or without tachycardia, almost invariably without exophthalmos, usually with nervous symptoms—tremor, slight weight loss, lymphocytosis and increased blood pressure—to the fulminating form with goiter, protruding eyes, palsy, prostration, emaciation and cardiac failure. Naturally no rigid scheme of treatment will fit all varieties of cases.

**Selection of Cases for Surgical Treatment.**—I know of no decision more difficult to make than whether a given case should be treated medically or surgically. Of the extremes in type mentioned above, neither should be operated. For others the elements in the decision, as I have experienced it, are as follows:

Medical treatment if persisted in for a year or more will cause improvement, amounting to from 25 per cent to 100 per cent, in 60 per cent of all cases. In other words the disease, in my opinion, runs a self-limited course, of one to four years, terminating in regression, more or less complete, in over 3/5 of all cases. The milder and more insidious the onset, the more likely is recovery to take place (and it is to be remembered that these mild cases of hyperthyroidism constitute a very large group of the inhabitants of doctors' waiting rooms). On the other hand, if a patient is advised to undertake medical treatment and gets worse under it, that patient is a worse surgical risk than before treatment was begun.

If surgical results were more certain, the decision would be less difficult, but my personal observation of the results of thyroidectomy would not lead to enthusiastic advocacy. Sooner or later after operation as Hertzler, a surgeon with enormous experience, is honest enough to say in his book on "The Diseases of the Thyroid Gland," most of these patients have recurrence of their symptoms and seek medical advice once more.

I have not found any easy "specific" method of diagnosis any more helpful. Neither the basal metabolic rate readings, nor the Goetsch test seems to me at all final. In lieu of any more exact means I recommend two considerations: the size of the gland is a guide to surgery—and so is the record of failure of medical treatment.

**Medical Treatment.**—*General Considerations.*—I have indicated above my reasons for believing in the feasibility of medical treatment, at all; to wit, that I believe most cases of thyroid intoxication tend to run a definite course to recovery. I know of no treatment which will tend to diminish or neutralize the secretion or to reduce the time during which the disease runs its course. Our principle object, then, during medical treatment is to protect the patient's organism and replace the functional ravages of the disease. It takes time, attention, patience and on the part of the patient, full understanding of the objects of treatment and character.

The main objects of care seem to me to be (1) to preserve the patient's nutrition, (2) to save the myocardium, (3) to save the nervous system.

The reading of the basal metabolic rate in these patients has given us very important hints as to treatment. Careful technicians have found

nearly universally that the basal metabolic rate is high in exophthalmic goiter and that the severity of the case usually corresponds to the amount of increase. Furthermore improvement will be shown by a reduction in the basal metabolic rate. This seems to me very important because it furnishes us with a standard of measurement.

No science can make much advancement unless it acquires a unit of measurement. Physics has been able to become as exact a science as it is because it has so many units of measurement—millimeters, degrees of heat, time units, ohms, amperes, etc. We should welcome, especially in therapeutics, which is still an art, any method of measurement, so long as it is reliable. Of course in exophthalmic goiter the basal metabolic rate is not our only method of measuring improvement or increase in severity. The pulse rate, the blood pressure, the weight, the patient's own feelings all help. But I believe the basal metabolic rate is the most delicate and on the whole the most reliable means, and should therefore be used.

*The essentials of medical treatment*, indispensable in all cases, are two:

1. Rest in bed.
2. Hyperalimentation.

The object of these two things is, of course, clear—to offset the ravages of the disease on the patient's nutrition.

Some compromise will usually have to be made in actual practice as to rest in bed. The ideal thing would be absolute rest in bed day and night until improvement occurs. It is much like a tuberculosis regime. But this ideal cannot always be fulfilled. For some patients, at work, it may be that getting to bed at six in the evening and staying there until morning will be the only possibility. Even this, however, may be a great help. I had one patient whom I told to get to bed as early as possible every night. I suggested 8:30. He did this faithfully for three months, and held his weight, but did not gain a pound. Then I told him to take off his clothes every evening and go to bed as soon as he got home—about 5:30—and have dinner served in bed. He did this, and in six weeks gained twenty-two pounds. Regardless of any other consideration I urge a preliminary absolute rest period of two weeks to a month. In any one's business a vacation of this length usually can be arranged.

A diet high in calories and everything else is the complement to rest. I see no object in selecting one sort of food over another. There is some theoretical objection to using protein because of its specific dynamic action, but in practice I see no point in this. I give all kinds of food in large amounts. The patients usually digest them well. The appetite

is good. One of my patients weighed 113 at the beginning of treatment. She stayed in bed two months, day and night, consuming about 6000 calories of food a day. At the end of that period she weighed 113 pounds. This illustrates what a tremendous consuming fire we are fighting. If patients have anorexia, frequent small feedings may be instituted.

*Other Means of Treatment.*—With the two essentials provided, other means of treatment may be selected. They consist in:

1. Removal of foci of infection.
2. X-ray.
3. Drugs.
4. Extracts of the ductless glands.
5. Specific antisera.
6. Psychotherapy.
7. Hydrotherapy.
8. Protection from the traumata of life.

**1. Removal of foci of infection,** especially in the head—diseased tonsils, teeth and sinuses—is of great value. The tonsils and their infections seem to have an especial influence on the thyroid; why, has not been satisfactorily explained. Hertzler has reported a series of cases of exophthalmic goiter having pelvic infections which were relieved by surgery to the pelvis alone.

**2. X-ray.**—The technic and the viewpoint of the radiologist are expressed in Chapter X.

There seems to be no doubt that exposure of the gland to the x-ray causes destruction of cells. The great disadvantage is the formation of extensive adhesions all over the gland, which make subsequent surgery nearly impossible. For this reason surgeons are opposed to the method. Holmes and Merrill report about 90 per cent of their cases relieved, as determined by comparative basal metabolism readings.

**3. Drugs.**—Iodine used either on the skin over the gland, or internally as in the form of sodium iodide, potassium iodide, tincture of iodine, syrup of hydriodic acid, etc., has been used, notably by quacks,* for a long time. We often hear tales of the diminution of goiter under its use. It has too much general tradition behind it for us to disregard it, and too little scientific sponsorship for us to recommend it.

Plummer of the Mayo Clinic has recently announced his results in the treatment of exophthalmic goiter with Lugol's solution. In the crises of this disease with vomiting, diarrhea, very rapid pulse, high basal

*I certainly do not mean exclusively by quacks.

metabolic rate and prostration this remedy works almost in a specific manner. It can be used after thyroidectomy equally well or better than before operation. The pulse rate and basal metabolic rate fall with almost mathematical accuracy, in properly selected cases. The dose is variable—3, 5 or 10 drops of the solution three times a day in a glass of water.

The explanation of the action given by Plummer is that in exophthalmic goiter there is not only an increased amount of thyroid secretion poured into the blood stream but there is also another substance never secreted by the thyroid gland in health which probably has an unsatisfied iodine radical. A case of my own will illustrate the value of the procedure. A young woman who had had her thyroid removed six months previously, wrote me from a distant city that she was still very nervous, that her pulse rate was 120 and that she was almost unable to do any of her work on account of weakness and tremor. I wrote her to take 10 drops of Lugol's solution three times a day. Ten days later she wrote me saying that on the sixth day after beginning to take these drops her nervousness disappeared as if by magic and her pulse rate fell to 60. When this occurs the administration of the drug must be stopped.

After its first exhibition it is a curious fact that if the symptoms reappear, a second administration of the iodine is not nearly so likely to be followed by another period of improvement. Its use then should be withheld until the question of surgical intervention has been decided, because it may be far more useful as a preliminary to operation; or if preoperative conditions are satisfactory, saved for postoperative emergency.

Toxic adenoma in my experience is not necessarily a bar to its use; although warnings against its use under such conditions are issued. Warnings are also issued against the danger of activating thyroids by the indiscriminate use of iodine.

*Lecithin.*—Berkley's advocacy of lecithin is very enthusiastic. His patients cling to it "as an opium habitue clings to that drug." It especially quiets the nervous irritability and quiets the tremor. Berkley's own experience may be valuable:

"The lecithin preparation is a product which in some instances requires careful handling. When there is disturbed digestion it is out of place, and in such an event other remedies that are better suited to allay and restore to its normal condition the disordered alimentary canal, must first be employed. Again, in certain cases, its action should be carefully watched, lest it induce extensive erythematous rashes, to the annoyance and discomfort of the patient. Furthermore, lecithin, *per se,* is an entire failure without the assistance and support of a milk diet. I can recall no instance of its complete success in either asthenia or Graves' disease when milk was not tolerated, and at least one liter

must be taken, daily, by the patient. We do not, however, rest on an entire milk diet in these cases, but allow all wheat foods, eggs, raw and cooked, all suitable green vegetables, as well as fruits, and only cut out meats, sweets and special foods which are known to disagree with the patient; and every one has his own food idiosyncrasies, which must be respected. Patience, the careful notice of trivial symptoms, as well as their judicious treatment, will repay in the increased comfort of the patient.

"That an increase in weight follows the administration of lecithin is rather singular when it is remembered that the active constituent is phosphorus, which together with iodine—the peculiar stimulant of the thyroid gland—is usually recognized as an exciter to the secretions of the named gland. Now, we have, apparently, the reverse action, the phosphorus nullifying the activity of the thyroid hormone, or to put it in the vulgate, we find the phosphorus compound stopping the active nervous symptoms in the two maladies, nervous asthenia and Graves' disease, maladies that upon the surface are entirely different in their etiology. The most plausible explanation of its powers is that it stimulates (through the agency of the leucocytes) the resistive powers of the tissues in general to greater activity; probably, also, it increases the secretions of the closed glands, such as the suprarenals and portions of the pancreas, as well as assists in erythrocyte formation and increases the phosphorus content of the leucocytes of the blood."

*Ichthyol.*—In the hands of some this, in combination with quinine, has proved very valuable taken by mouth in the dose of 1 grain three times a day.

*Quinine.*—Of all drugs this is the one I use as a routine most frequently. Forcheimer says:

"The good effects under this treatment usually follow in the same sequence; first, the tachycardia improves, the pulse frequently coming down from 130-140 pulse beats to 80 or 90 in forty-eight hours. Secondly, the thyroid gland diminishes in size, by measurement. Thirdly, the tremor and exophthalmos disappear. In by far the greater number of cases the exophthalmos is the last symptom which disappears; indeed, in a goodly number of patients it never disappears. To convince one's self that the treatment is the cause of the changes just noted, it is necessary only to withdraw the pills and, unless the patient is cured, the symptoms recur. If, after the withdrawal of the pills the symptoms disappear, such patients, as a rule, may be considered cured. Relapses are not uncommon; these patients have relapses on account of psychic or physical irritations and these relapses should be treated in the same

way as before. It is on account of these relapses that the disease may last so long. The treatment just described is most valuable in the mild attacks, the percentage of complete recoveries being very large and after a short time. When the fully developed form exists, either primarily or as a relapse, complete recoveries are the rule, but more time is required. When the patient has the foudroyant form the results are excellent."

Jackson and Mead introduced to me the use of quinine hydrobromate. I give it in capsules gr. v, if the patient can tolerate it, three times a day. If idiosyncrasy occurs, I reduce the dose correspondingly.

*Arsenic, Iron, Digitalis, and Bromides,* are used for obvious symptomatic reasons.

**4. Extracts of the Ductless Glands.**—*Thyroid extract* could only be used on the supposition that the syndrome of Graves' disease is due to a perverted thyroid secretion, not to a superabundant thyroid secretion.

*Ovarian extract* may be used in some of the cases in which menstrual disturbances are prominent in the picture.

*Pituitary extract*—(posterior lobe—pituitrin). Pal has a large and favorable experience with this substance. It is given subcutaneously in doses of 5 minims (⅓ c.c.) or more (up to 30 minims 2 c.c. in 24 hours).

**5. Specific Sera.**—*Thyroidin* or *antithyroidin* is prepared from the serum of thyroidectomized sheep. It is given by mouth and hypodermically. The dose is 10 to 20 drops three times a day.

Rogers and Beebe prepared a cytolytic serum by injecting the extract of thyroids from exophthalmic goiter patients into rabbits. The serum is not used much at present.

**6. Psychotherapy.**—Keeping the patient hopeful and determined is a very important object which must be attained with positive conscious encouragement. A very interesting book to read on this subject is Bram's "Nonsurgical Treatment of Exophthalmic Goiter."

**7. Hydrotherapy.**—The wet pack, the affusion, the cold shower and forms of institutional hydrotherapy are valuable adjuncts.

**8. Protection of the patient from the traumata of life**—pregnancies, business worry, war, etc., should be put as a major element of treatment. It is not always possible, but it may always be attempted.

### C. Deficiency of Thyroid Secretion—Myxedema and Cretinism

See Chapter V, Part I.

## II. DISEASES OF THE PARATHYROID GLANDS

Tetany is the symptom associated with disease of the parathyroids. Tetany is a hyperexcitability of the nervous system, accompanied by spon-

taneous (and inducible) attacks of tonic spasms of the muscles, most often of the hands and face. It may occur in various conditions.

1. *Rickets.*—Infantile tetany is probably the most frequent form.

2. *Gastric Tetany.*—Spasms of arm, hand, leg and other muscles, associated with gastric dilatation, pyloric stenosis, prolonged vomiting, duodenal ulcer, etc.

3. *Tetany due to parathyroid extirpation* (formerly an accidental occurrence in the course of thyroid operations).

4. *Endemic Tetany.*—Reported from Vienna and a few other European cities.

5. *Infectious Diseases.*—Tetany occurs during the course of some of these.

6. *Tetany during Pregnancy.*

7. *Due to Forced Respiration.*—Grant and Goldman have reported the experimental production of tetany in normal subjects, after forced hyperpnea. The urine is full of phosphates soon after the induction of forced breathing, apparently due to the attempt on the part of the body to maintain the normal H-ion concentration, the sweeping out of the $CO_2$ from the blood making it more alkaline. The tetany may be due to some disturbance of the inorganic mineral metabolism. There was found, however, a slight increase of the calcium content of the blood.

The usual explanation of tetany is that it is due to a disturbance of mineral metabolism, a lowering of the concentration of calcium in the blood and tissues. Many physiologists, (Loeb, Howell and others) have demonstrated that the balance of the ions of sodium, potassium, calcium and magnesium gives a stability to the tone of the skeletal muscles. If the sodium and potassium ions predominate, the muscles will be very irritable and go easily into spasms. The addition of calcium will calm the irritability and stop spasms of the muscle. MacCallum and Voegtlin showed that the blood serum and brain tissue in parathyroidectomized animals were deficient in calcium. Kramer, Tisdall and Howland found, in the blood serum of patients with tetany from rickets, that the sodium, potassium, and magnesium ions were present in their normal concentration, while the concentration of calcium is regularly lowered. The administration of calcium salts intravenously in tetany is followed by a cessation of the spasms which lasts for twelve to twenty-four hours. The conclusions these varied workers come to is that the spasms of tetany are due to the absence of calcium in the circulating blood, the sodium and potassium salts producing their stimulating effect unopposed.

What part the parathyroids play in all this is simply speculative. They exercise a regulatory influence on calcium metabolism. Whether or not all forms of tetany have a unified origin in dysfunction of the

parathyroids is also speculative. Parathyroid extract has proved successful in the treatment of tetany.

The views above outlined have not gone altogether unopposed. Berkley and Beebe point out that there are several clinical conditions known in which calcium is excreted at an abnormal rate—as in diabetic acidosis—and yet no tetany develops. They found too in animals with experimentally induced tetany, that if one-third of the blood be withdrawn and replaced by normal saline solution the spasms are promptly relieved. Here we have a sodium salt relieving the spasms, when we should expect it to make them worse. While the evidence is somewhat conflicting the larger weight of it is on the side of the calcium depletion theory.

The treatment of tetany becomes obvious. Where possible the cause should be treated—in rickets with sunlight, cod-liver oil, diet and calcium salts; in gastric disease with surgery, gastric lavage, etc. In all cases the intravenous administration of calcium salts will give symptomatic relief. This should be combined with injections of parathyroid hormone (see chapter on Ductless Glands). A bit of speculation of fascinating import concerns the possibility of other spasmophilic diseases, such as chorea, epilepsy, Parkinson's disease, etc., being due to a calcium (and parathyroid) deficit.

The other diseases of the ductless glands are described in Chapter IV, Part I.

## References

### *Thyroid Gland*

Berkley, H. J.: Bull. Johns Hopkins Hosp., September, 1908.
Hertzler: Diseases of the Thyroid Gland, St. Louis, 1922, C. V. Mosby Co.
Hertzler: The Relation of Pelvic Disease to Exophthalmic Goitre, Jour. Am. Med. Assn., December 23, 1911, lvii.
Holmes and Merrill: The Treatment of Thyrotoxicosis by Means of the X-ray, Jour. Am. Med. Assn., November 29, 1919, lxxiii, No. 22.
Jackson and Mead: Boston Med. and Surg. Jour., 1908, clviii, No. 7.
Kimball: Prevention of Simple Goitre in Man, Am. Jour. Med. Sc., May, 1922, clxiii, No. 5.
Marine and Kimball: Prevention of Simple Goiter in Man, Jour. Am. Med. Assn., October 1, 1921, lxxvii, No. 14, p. 1068.
Means and Holmes: Further Observations on the Roentgen-Ray Treatment of Toxic Goiter, Arch. Int. Med., March, 1923, xxxi, No. 3.
Pal: Semaine Med. Jour., January 28, 1914.

### *Tetany*

Freudenberg and Gyorgy: Klin. Wchnschr., 1922, i, 410.
Grant and Goldman: Am. Jour. Physiol., 1920, lii, 209.
Kramer, Tisdall and Howland: Am. Jour. Dis. Child., November, 1921, xxii, 431.
MacCallum, et al: Bull. Johns Hopkins Hosp., 1920, xxxi, 1.
Moffitt: Tetany in Adults, Jour. Am. Med. Assn., 1911, lvii, No. 6.

## CHAPTER XXIII

## THE TREATMENT OF THE CHRONIC INTOXICATIONS

### 1. ALCOHOLISM

Several varieties of alcoholic intoxication, differing in severity, require medical treatment.

Acute alcoholism—not the result of prolonged excess or one of repeated indulgences. The patient is simply getting over a jag. The symptoms are tremor, restlessness, inability to stabilize the mental functions and extreme mental depression and remorse. There are no deliriums or hallucinations.

The items in treatment are: (1) isolation from alcohol and family and immediate withdrawal of all drink. Do not withdraw the alcohol gradually; (2) *drugs,* hypnotics or depressants to control the nervousness, induce sleep until twenty-four to forty-eight hours have gone by when the tremor will be better and the appetite restored. Morphine, 1/4 grain, repeated if necessary, fills the bill best of all; (3) encourage eating and copious water drinking; (4) elimination by catharsis, enema, or sweat baths; (5) and probably most important *psychotherapy*—assurances that the patient is not forever disgraced, or financially, or domestically ruined, and encouragement of good resolutions for the future—for further suggestions see below under psychotherapy for chronic alcoholism.

**Chronic alcoholism** may take one of two forms: (a) the steady daily drinker who is never drunk and who is almost helpless from a therapeutic standpoint. He may be frightened or persuaded to stop, which must be done abruptly (not by gradual withdrawal) and fortified by the measures recommended for acute alcoholism, to get the victim over the acute stage of withdrawal. A thorough **psychic analysis** of the cause for the chronic indulgence and helpful psychotherapy are by all odds the most important elements in treatment.

In practicing psychotherapy on these patients, it is important to remember one of the fundamental psychotherapeutic rules, which is to substitute something positive for them to think upon, not simply a negative prohibition. Do not say, "It is dreadful, disgraceful and expensive for you to drink," but say, "After all you have gotten to the stage where you get very little effect from your liquor. You never have any exhiliration any more. Why continue to use it?"

(b) The occasional drunkard, who goes on a spree or bender sometimes lasting for months, must be treated in two ways: First, to get

him over the acute stage of withdrawal the measures recommended above—abrupt withdrawal, isolation, morphine or paraldehyde to mitigate the initial nervousness; and second, good psychotherapy to divulge the underlying cause of the sprees. Drunkenness is really, it must be remembered, a form of suicide—an attempt on the part of the victim to escape from himself. The question the physician has to answer is, "Why does he wish to escape?"

**Delirium Tremens** may complicate any of these conditions.

The mortality is 40 per cent in untreated, and about 20 per cent in properly treated cases. The symptoms are extremely profuse, clammy perspiration, coarse tremors, clouding of the mind, hallucinations, especially of the visual and auditory types; ideas that myriads of strange and fantastic animals are attacking the victim, sleeplessness, and apprehension. Variations are common—the hallucinations may be absent, or, instead of apprehension, the patient may be in gales of laughter.

The treatment consists in:

(1) Isolation.

(2) Gradual withdrawal of the drug. Cutting down the daily dose one-half.

(3) Elimination. Calomel grains iii-v, with colonic irrigation. Hypodermoclysis or saline transfusion may be practiced in severe cases to dilute the toxins and start diuresis.

(4) Keep up the fluid content of the body by giving large amounts of water. When a good deal of fluid has been introduced, begin saline catharsis and keep up fluid intake.

(5) Support the heart with camphor and adrenalin. Some clinicians insist on the use of spartein sulphate (grain ii, or gram 0.13) every three hours.

(6) Encourage food intake.

(7) *Caution:* Use sedatives and hypnotics sparingly in actual delirium tremens. Jewett states that since abandoning their use his mortality has improved 50 per cent. He advises either gelsemium in the form of the alkaloid gelseminin $\frac{1}{25}$ grain by hypodermic every two hours, or a continuous bath for sedative effects.

The treatment may be modified according to the severity of the case. Repeated lumbar puncture and drainage have been used.

## 2. OPIUM HABIT, MORPHINISM, HEROINISM

The use of opium itself is seldom encountered any more. In the old days smokers and chewers of gum opium were common. Heroin addicts predominate in New York and seaport cities (90 per cent); in inland cities (4 per cent of drug addicts in Chicago use heroin) morphine addicts

are more frequent. The principles of treatment are the same for all forms. These are:

(1) Understanding by the physician of the physical and psychic make-up of the patient. On the physical side the extreme constipation, and motor fixation of the intestines induced by the drug, with the drying up of all secretions has created a condition which the specialists in these disorders call a toxemia (no one knows just what this toxemia is but that a peculiar physiologic state exists there is no doubt).

On the psychic side the physician must regard his patient as the victim of a disease, not as a criminal or weakling. Those who treat the drug addict are all too prone to regard him as to blame for his condition, which is like the mental attitude of one who should treat a typhoid patient as if he had deliberately caught the typhoid bacilli. The intellectual level of the drug addict varies greatly: only 5 per cent of those admitted to Bellevue Hospital were of normal adult intelligence.

(2) Isolation is necessary. The most important part of isolation is prevention of accessibility to the drug. This is not so simple as it sounds. The patients, even if they decide voluntarily to take the cure, will arrange beforehand to have the drug smuggled to them. They often enter the hospital with a good supply, even concealing it in the rectum or vagina.

(3) The general condition of the patient must be ascertained—whether he has been without the drug for some hours or has loaded up on it preparatory to starting a cure, putting off the evil hour of the beginning of withdrawal symptoms.

(4) Elimination and catharsis must be vigorously instituted. Usually the first symptoms of withdrawal are abdominal cramps and diarrhea, but stimulation of the intestines is necessary just the same. Strychnine is the best drug for this, given in enormous doses. Saline transfusion and baths may also aid elimination.

(5) A drug for replacement after withdrawal. Hyoscine is the best of these. There is as yet no specific for any form of drug addiction.

(6) Gradual withdrawal of the drug is usually necessary. Magendie's solution (liquor morphinae hypodermicus N.F. 1/6 grain morphine in every 5 minims) is useful to have around, the dosage being easily gradable.

The treatment recommended by Dr. Alexander Lambert in 1909 and known as the Towns-Lambert Treatment is a good, definite method of treatment for the general practitioner. It is worth while recalling that the title of the original paper was "The Obliteration of the Craving for Narcotics" and that the first sentence ran as follows: "If some years ago any one had told me that it was possible to take the desire for morphine, cocaine or alcohol away in less than five days with a minimum of

discomfort and suffering to the patient, I should have felt justified in treating the statement with a polite skepticism." The principal prescription used is:

℞

| | |
|---|---|
| Tincture belladonnae | gm. 62 |
| Fluid extracti xanthoxyli | gm. 31 |
| Fluid extracti hyoscyami | gm. 31 |

As, when this prescription is given, the patients do not suffer from the intense diarrhea which usually accompanies the withdrawal of morphine, it is necessary to give very intensive cathartic medication, and this forms one of the most important parts of the treatment. This is accomplished with the compound cathartic pills and vegetable cathartic pills of the Pharmacopea.

C.C. Pills:

| | gm. | gr. |
|---|---|---|
| Extracti coloynthidis compositi | .08 | 1⅓ |
| Hydrargyri chloride mite | .06 | 1 |
| Cambogiae | .016 | ¼ |
| Resinae jalapae | .02 | ⅓ |

The vegetable cathartic pills:

℞

| | gm. | gr. |
|---|---|---|
| Extracti colocynthidis compositi | .08 | 1 |
| Extracti hyoscyami | .03 | ss |
| Extracti jalapae | .03 | ss |
| Extracti leptandrae | .015 | ¼ |
| Extracti resinae podophylli | .015 | ¼ |
| Olei menthae pipentac | .008 | M.⅛ |
| Oleoresin capsici | .006 | 1/10 |
| Oleum tiglii | C.C. .0025 | M.1/25 |

The last two ingredients are optional, recommended by Dr. Lambert and not part of the formula of the official vegetable cathartic pills. The compound cathartic pills should be made up fresh as the stock preparations are usually too dry to be effective.

**In outlining the treatment** the first preparation will be called *the belladonna mixture;* the compound cathartic pills, *the C.C. pills;* and the vegetable cathartic pills, *the B.B. pills.*

For a morphine, heroin or cocaine case:

(1) Before beginning treatment give four C.C. pills and grains v of blue mass. Also a soapsuds enema until the rectum and sigmoid are cleansed.

(2) When catharsis is established begin with the belladonna mixture, 3 to 6 minims every hour. (In the original article Lambert said, "6 to 8 minims," but in his latest writings he says, "6 drops [from a glass dropper], not minims." My own interpretation of these directions is as

given in the text.) Continue this throughout the treatment or until signs of belladonna intoxication are observed. Every six hours increase the belladonna mixture two minims until 14-16 minims are being taken. Do not go above 16 minims. If belladonna intoxication symptoms occur stop the mixture until their subsidence and then start it again at 6-8 minims.

(3) With the first dose of the specific give one-half to one-third of the usual total dose of the narcotic drug the patient is accustomed to take. Divide the amount into three doses and give at half-hour intervals, either by mouth or by hypodermic.

(4) Fourteen hours after the first dose of the belladonna mixture give 4 C.C. pills and grains v of blue mass. Six hours later repeat the C.C. pills and give four to six B.B. pills. It is essential that the bowels should move at this time.

(5) After the bowels have moved give one-half to one-third the original dose of the narcotic.

(6) Twelve hours later give 4 C.C. pills or 4 to 6 B.B. pills with grains v of blue mass.

(7) Six hours later give an ounce or more of castor oil. Some codeine (grains i-iii) may have to be given at this stage. Magnesium sulphate 15 per cent solution 5 c.c. by hypodermic may be given with the codeine; or even alone it has a good effect. The castor oil at this time will produce a characteristic stool which shows that the entire treatment may stop. This is a liquid green stool, composed of mucus and bile. When this stool occurs, or shortly afterwards, the patients will often feel suddenly relaxed and comfortable and their previous discomfort ceases. The transition from discomfort to relaxation and contentment is often strikingly marked.

Pettey's treatment, suggested by Dr. George E. Pettey of Memphis, Tennessee, depends upon the use of large doses of strychnine. The strychnine acts by increasing the tone of the bowel especially and as a general stimulant. Pettey's preparation is made up as follows:

℞

| | | |
|---|---|---|
| Calomel | | |
| Cascara | āā gr. x | (0.65 gm.) |
| Ipecac | gr. 1 | (0.065 gm.) |
| Strychnine nitrate | gr. ¼ | (0.0162 gm.) |
| Atropine sulphate | gr. 1/150 | (0.0013 gm.) |

Mix and Make Four Capsules.

The dosage of strychnine it will be observed is very high, but is necessary and safe in these cases.

*First Day:* In using this treatment one capsule is given at 4, 6, 8, and 10 P.M. of the day beginning treatment.

*Second Day:* At 6 A.M. $\frac{1}{30}$ grain of strychnine is given hypodermically, and two ounces of castor oil or a bottle of magnesium citrate, repeating at 8 and 10 P.M. if no results are obtained. No breakfast is given. None of the narcotic drug is given until after free purgation has begun. Then one-half the usual dose is given.

Following this, a quart of normal saline solution is given in a vein of the arm. It should be explained to the patient that this is given to dilute toxins, to replace the loss of fluid from catharsis and to bring about elimination through the kidneys. Give a light supper but no cathartic that night.

*Third Day:* One capsule at 4, 6, 8, and 10 P.M. No supper. Small amounts of the drug if necessary.

*Fourth Day:* At 6 A.M. $\frac{1}{30}$ grain of strychnine by hypodermic, and oil or salts. After the bowels have acted, a small dose of the narcotic. The patient should now begin to get along on one grain of morphine divided into three or four doses a day. In the afternoon a quart of saline in the vein.

*Fifth Day and beyond:* Try to remove the drug completely. Give hypodermics of sterile water or use hyoscin to tide over the discomfort (gr. $\frac{1}{200}$ or $\frac{1}{100}$ will usually suffice). Continue with purgation, and sparteine sulphate (gr. i to ii) for the bracing effect, and normal saline infusion until better conditions prevail.

## 3. COCAINE HABIT

Cocaine does not appear to form the sort of tissue fixations which morphine and heroin and opium do. It is taken for the immediate psychic effects. It is therefore an easier habit to break immediately than the opium habit, but relapses are more common. Most cocaine users are mental defectives. Withdrawal of the drug, isolation and catharsis are usually sufficient to break the habit. Isolation may have to be carried to the point of restraint. The pure cocaine habitué, however, never suffers physically from withdrawal as the morphine habitué does. When the cocaine habit is combined with the morphine or heroin habit it should be treated as for morphine or heroin.

## 4. HYPNOTIC HABIT

Chloral, paraldehyde, other hypnotics, veronal, medinal, etc., habits may be treated (symptomatically that is) by isolation, withdrawal, and stimulation. Chloral usually induces grave physiologic circulatory weakness which must be watched.

## 5. CARBON MONOXIDE POISONING

"Deaths from carbon monoxide poisoning in large cities now exceed those from any other poison." "Carbon monoxide has probably replaced lead as the most important industrial poison," according to McNally and Henderson. Carbon monoxide is produced by the imperfect oxidation of carboniferous material; poisoning can occur from the inhalation of gas from gas stoves, oil stoves, base burners, illuminating gas, automobile exhausts, etc. Coal gas contains 16 per cent, the exhaust from automobile motors, 7 per cent.

Special warnings should be issued for those cases which originate from running an automobile in a small closed garage. I know of one death and one nearly fatal poisoning from this source. The short length of time the car needs to run and the almost instantaneous effect of the gas are noteworthy. One patient went into his garage on a cold winter morning and started the engine of his car so it would be warmed up when he went outside. Re-entering it he was instantly overcome and two minutes later discovered unconscious, and only with difficulty revived by artificial respiration in the open air.

Carbon monoxide has an affinity for hemoglobin three hundred times that of oxygen. The red corpuscle, however, will lose its carbon monoxide and take up oxygen provided atmospheres with oxygen under sufficient tension are provided. A certain concentration of carbon monoxide is necessary before poisoning is produced. Haggard and Henderson ridicule the idea of harm from the ordinary inhalation of automobile gas in the streets. Chronic poisoning characterized by anemia and fatigue has, however, been reported.

The treatment of the acute case is artificial respiration, by the Schafer prone pressure method. Inasmuch as I have just searched three textbooks on therapeutics without finding any account of a method for artificial respiration, and as two books on nursing which I have consulted have described only the methods of Marshall Hall and Silvester, and inasmuch as the various Research Committees have unanimously recommended Schafer's method as the best after experimentation, perhaps I may call attention to it as described in Chapter XIII.

Oxygen administration by inhalation, while artificial respiration is being carried out, accelerates the release of CO from the hemoglobin. A certain amount of carbon dioxide in the oxygen—5 per cent—is even more effective, as pointed out by Haggard and Henderson. This is logical as carbon dioxide is the natural stimulant of respiration.

## 6. ARSENICAL POISONING

Arsenical dermatitis is encountered in average clinical practice, aside from industrial practice, most frequently as an accident in the treatment of syphilis with arsenicals.

Here sodium thiosulphate acts as a specific by precipitating the arsenic as a nontoxic insoluble sulphide. It should be given both intravenously (0.3 gram the first day; 0.45 gram the second day; 0.6 gram the third day; 0.9 gram the fourth day; 1.2 gram the fifth day; 1.8 gram the eighth day) and by mouth (1 gram in water three times a day). To be effective intravenous and oral administrations must be combined. H. A. Metz Laboratories put up the drug in crystalline form, as it deteriorates in solution. A clean, pure and sterile drug is imperative. The preparation of the intravenous solution is similar to that of neoarsphenamine: the solution should be filtered prior to use.

## 7. MERCURY POISONING

Acute mercury poisoning from the ingestion of bichloride of mercury, either accidentally or with suicidal intent, is a common occurrence. The lethal dose is difficult to determine. Sansum showed that per kilogram of dog 4 mg., when injected intravenously, were fatal. But in clinical practice such calculations fail, as the drug is taken by mouth and early induces vomiting which evacuates a certain amount; even if vomiting does not occur, absorption may be variable depending on the amount of food in the stomach. Haskell, Carder and Coffindapper found that 20 mg. per kilo. of dog by mouth in a fasting condition, when vomiting was prevented by narcotics, was the minimum lethal dose. This would equal, roughly, one grain to ten pounds of dog. For human beings of average weight 5-15 grains may be considered the lethal dose. Most antiseptic bichloride tablets on the market are put up in sizes 7½ and 1⁸⁄₁₀ grains. The first duty of the physician in attendance on these cases is to determine, if possible, whether a lethal dose has been absorbed. Much of the confusion attending the evaluation of therapeutic methods arises from a lack of accurate data on this point.

Mercury produces a gastritis, a gastroenteritis, a slowly developing nephritis, and later a hepatitis. Death occurs usually from renal or hepatic failure three to ten days after absorption. The attendant physician must, therefore, watch the urine for albumin and casts, and the blood for evidences of nitrogenous and acid retention. Weiss guides treatment and determines the danger point by the reaction of the urine to methyl red. While it shows acid, danger threatens, and to keep it alkaline is the desideratum. The immediate treatment, provided the patient is seen soon enough, is the standard one of administration of milk and eggs. The object is to precipitate the mercury with some form of albumin while it is still in the stomach, and before absorption. It must be given then within an hour at the least after ingestion of the

drug. Barlow and Biskind have reported a carefully checked series of cases by this method. Milk was found quite as effective as eggs, or more so, as it spreads more rapidly and thoroughly over the stomach. Emesis, or gastric lavage, should always be instituted, preferably emesis, as the stomach tube may become clogged. The use of milk should be continued for several days.

The use of specifics such as calcium sulphide and sodium thiosulphate, which aim to precipitate the mercury in the blood and tissues and allow it to be excreted as nontoxic insoluble sulphides, while not certainly helpful, should be instituted in every case as they are harmless and in many cases result favorably. Careful attention to details should be instituted. The drug sodium thiosulphate should be given by mouth as well as intravenously. For details of administration see above under Arsenical Poison.

Calcium sulphide, originally advocated by Wilms, is given intravenously in a solution of one grain of calcium sulphide in one ounce of water for every grain of the bichloride taken. The solution is boiled and filtered through cotton. Fresh calcium sulphide should be used as deterioration in the old product occurs, resulting in the formation of hydrogen sulphide which can cause convulsions.

There is no reason why this specific treatment should not be combined with the routine method advocated by Lambert and Patterson of forcing fluid, and the administration of alkaline diuretics and hot packs with colonic irrigation. The following treatment recommended by Weiss should result in about 94 per cent of recoveries:

(1) Wash out the stomach with a saturated solution of bicarbonate of soda, continuing until washings are clear. Two liters of the solution should be used. Before withdrawing the stomach tube introduce 6 ounces of a saturated solution of magnesium sulphate into the stomach.

(2) Give a soapsuds enema.

(3) Give 1000 c.c. of Fischer's Solution in the vein to combat acidosis. (Fischer's Solution: Crystalline sodium carbonate 10 gm., sodium chloride 15 gm., distilled water one liter.) Repeat daily.

(4) Give a beverage made by dissolving 4 gm. (1 teaspoon) of potassium bitartrate and 2 gm. (½ teaspoon) of sodium citrate in a glass of water, orangeade, or lemonade, six to eight times daily.

(5) Colonic irrigation or hot packs may be given.

Carter's antidote, sodium phosphate, will change the bichloride to calomel in vitro, it is claimed. "Carter recommends 5 to 10 grains of sodium phosphate per grain of mercury taken plus five grains of sodium acetate in a half glass of water every hour."

## 8. LEAD POISONING

Lead is absorbed more rapidly through the respiratory tract than by way of the gastrointestinal tract. It can, however, be absorbed through the intact skin and through the mucous membranes of the mouth and nose. It does not take a large amount of lead absorbed to cause severe poisoning—1.33 grams of lead acetate, or 750 mg. of metallic lead, in a case reported by Aub. Mining, smelting, painting and printing industries expose workers to lead poison. But certain cosmetics—"Flake White" face powder as reported by Barron and Habein, and grease paint used by actors may cause all the symptoms. Abdominal cramps, "lead colic," with severe constipation, anemia and palsy, particularly of the most used muscles of the arms and the eye muscles, are the effects of the poison needing treatment.

An understanding of the chemical pathology of the disease is necessary to effective therapy. Lead is carried in the blood stream as a phosphate. It is stored in the solid parts of the bones. Not until it begins to be absorbed from the bones is any damage done. Poisoning occurs only as lead is circulating either from absorption from outside sources, after the bones become more or less saturated, or when it is liberated from the bone deposits.

Aub and Minot found that a decrease of the calcium in the food, resulting in a low calcium balance in the body tissues, favored the rapid liberation of lead from the bony storage areas. On the contrary, a high calcium content of the blood favors retention of lead in the bones. In acute cases of plumbism, therefore, they have used a very high calcium diet, two quarts of milk and three grams of calcium lactate daily, as this tends to reduce the presence of the poison in the circulation. When the case is no longer acute, on the contrary, and it is desirable to hasten the liberation of the deposits in the bones, a low calcium diet is administered, augmented by large doses (8 to 12 gm.) of ammonium chloride daily, or ten doses of 20 to 25 c.c. of dilute phosphoric acid so sweetened and diluted that it tastes like lemonade. "A small amount of gin," I am happy to announce, is advised by these researchers, to make the drink more palatable.

The use of iodide of potassium, the classic specific advocated by Melsens in 1840 and ever since used, unquestionably increases the excretion of the lead in a chronic case. It forms a soluble lead iodide, which is then excreted by the kidneys, and *too much of the drug* can easily be given, resulting in the appearance of highly dangerous amounts of lead in the circulation. Not more than ten grains (0.56 gm.) three times a day should therefore be given.

Catharsis, the classical drug recommended being magnesium sulphate, is indicated both because excretion occurs from the bowels, and because constipation is so marked a feature of the condition.

**Treatment of the Special Symptoms.**—*Colic* should be treated with hot applications to the abdomen, nitroglycerin and atropine. The *anemia* is usually self-limited, though iron has been given. For *palsy* massage and electricity and time usually result in restoration of function in from four to nine months.

The prevention of lead poisoning, a very complicated subject on which I have no first-hand knowledge, should be studied in the special books on industrial poisonings.

## 9. FOOD POISONINGS

Food poisoning may be due to eating food to which the patient is allergically susceptible, to eating foods such as inedible mushrooms which are actually poisonous, or to eating foods which have been contaminated with bacillus botulinus and are impregnated with its toxin, or to eating food which is infected, the usual infection being by one of the group resembling Gaertner's bacillus. It is the latter type which is usually meant when food poisoning, or the old term ptomaine poisoning, is referred to. Ptomaines do not enter into food poisoning at all and the term is falling into disuse.

(1) **Allergic reactions** are fully dealt with in a special chapter in this book.

(2) **Mushroom poisoning** is due to the ingestion of mushrooms containing muscarine: these are largely of the *Amanita* group. Muscarine has an action similar to pilocarpine. It is not destroyed by cooking. Atropine is the physiologic antidote. Emesis, catharsis and supportive measures will have to be instituted along with its administration. Most cases occur when amateur botanists associated with picnic expeditions demonstrate their fearlessness, as the mushrooms sold in markets are practically all cultivated.

(3) **Botulism** is an extremely fatal disease. Epidemics following the ingestion of olives, ripe olives, spinach, beets, corn, ham, sausage and cottage cheese have been reported. The symptoms are due to the action of the toxin of the bacillus which has been elaborated in the food before it is eaten. The toxin is destroyed at a temperature of 75° C. in ten minutes.

The only effective treatment is by administration of the antitoxin for the particular toxin involved (see Chapter III). As the toxins of the various strains of the bacilli all have affinities for the nervous system, and as some act on the motor end-plates of the muscles, producing a

curare-like paralysis, artificial respiration may be necessary over long periods of time.

(4) Food poisoning by *Gaertner's bacillus,* or *bacillus enteritidis* is a true infection, not a toxemia, producing a quite characteristic group of symptoms and running a fairly definite self-limited course, usually ending in recovery, but with a mortality of 1.5 per cent. In a fatal case, seen by myself, a bacteriologist cultivated organisms (Gram-negative and not fermenting as all this group are) from multiple punctate liver abscesses. Most of the cases arise from meat eating; fish, lobsters or oysters are not the usual causes. The meat is probably infected by rats or mice, as these animals are carriers of the organisms. The food does not smell or look tainted. Infected milk will cause large epidemics.

The symptoms are fever, diarrhea, nausea, vomiting, and prostation. The treatment is to limit food to water, insist on rest in bed and give salol, bismuth subnitrate or paregoric.

## 10. BROMIDE INTOXICATION

Poisoning by bromide compounds may be a result of medication, resulting in bromide eruptions, respiratory hypersecretion and mental sluggishness. Wile has reported a valuable method of treating the condition, so that all the signs are relieved weeks sooner than would be the case if the bromides were merely withdrawn and the eruption, etc., allowed to subside as the bromides slowly left the body. The treatment is based upon the experimentally demonstrated facts that ingested bromide is with difficulty passed through the renal epithelium, and that consequently salts of bromide tend to be stored in the body tissues. Most important of all, bromide tends to replace the chlorine ion in the body, the ingestion of bromides leading to the rapid elimination of chlorides. On the contrary, after the bromides have been stopped, the introduction of physiologic sodium chloride solution intravenously leads to the liberation of bromides from the tissues and to the rapid and immediate influencing of the skin eruption and mental torpor. The elimination of bromide is so rapid that it appears to cause a renal irritation and the treatment must be carefully guided by frequent urinary examinations. The initial dose of normal saline should be 100 to 150 c.c. If well tolerated, this may be increased to 300 to 400 c.c. given twice weekly.

### References

*Opium, Morphine, Alcohol, etc.*

Janet: Alcoholism in Relation to Mental Depression, Jour. Am. Med. Assn., November 5, 1921, lxxvii, No. 19.

Lambert: The Obliteration of the Craving for Narcotics, Jour. Am. Med. Assn., September 25, 1909, liii, No. 13.

Sceleth and Kuh: Drug Addiction, Jour. Am. Med. Assn., March 1, 1924, lxxxii, No. 9.

### *Hypnotics*

Lands: Barbital (Veronal) Intoxication, Jour. Am. Med. Assn., November 3, 1923, lxxxi, No. 18.

Leak and Ware: Barbital (Veronal) Poisoning, Jour. Am. Med. Assn., February 7, 1925, lxxxiv, No. 6.

### *Carbon Monoxide*

Haggard and Henderson: The Treatment of Carbon Monoxide Poisoning, Jour. Am. Med. Assn., October 1, 1921, lxxvii, No. 14.

Henderson: Resuscitation, Jour. Am. Med. Assn., September 6, 1924, lxxxiii, No. 10.

McNally: Carbon Monoxide Poisoning, Jour. Am. Med. Assn., November 10, 1917, lxix, No. 18.

### *Mercury Poisoning*

Carter: Chicago Med. Rec., 1914, xxvi.

Haskell, Carder and Coffindapper: The Value of Forcing Fluid in the Treatment of Murcuric Chlorid Poisoning, Jour. Am. Med. Assn., August 11, 1923, lxxxi, No. 6.

Kuhn and Resse: Sodium Thiosulphate in the Treatment of Metallic Intoxication, Jour. Am. Med. Assn., December 5, 1925, lxxxv, No. 23.

Lambert and Patterson: Poisoning by Mercuric Chloride and Its Treatment, Arch. Int. Med., November, 1915, xviii, No. 5.

Sollmann, Barlow and Biskind: Eggs and Milk as Antidotes Against Mercuric Chloride, Jour. Am. Med. Assn., February 26, 1927, lxxxviii, No. 9.

Weiss: Mercuric Chloride Poisoning, Arch. Int. Med., February, 1924, xxxiii, No. 2.

### *Lead Poisoning*

Aub, Minot, Fairhall and Rezmkoff: Recent Investigations of Absorption and Excretion of Lead in the Organism, Jour. Am. Med. Assn., August 23, 1924, lxxxiii, No. 8.

This paper has attached a complete bibliography of the numerous papers of these investigators on the subject. They have also written a book ''Lead Poisoning,'' published by Williams and Wilkins, Baltimore, 1926.

Barron and Habein: Lead Poisoning with Special Reference to Poisoning from Lead Cosmetics, Am. Jour. Med. Sci., December, 1921, clxviii, No. 6.

Hamilton, Alice: Industrial Poisons in the United States, New York, 1925, MacMillan Co.

### *Bromide Intoxication*

Wile: Bromide Intoxication, Jour. Am. Med. Assn., July, 1927, lxxxix, No. 5.

# CHAPTER XXIV

## THE TREATMENT OF DISEASES OF THE ORGANS OF LOCOMOTION

Fortunately for me, I do not have to present a classification of chronic arthritis and chronic myositis. The methods of treatment employed in what the patient calls (and quite properly, I think, in spite of the protests from rhetorical purists) "chronic rheumatism," are all very much the same and can be unified here. They may be considered under the following heads:

**I. Focal Infection.**—The hypothesis upon which this doctrine rests is that changes in distant parts of the body may be brought about from a remote focus of infection. The changes in the distant parts are inflammatory in nature and may be due to the actual localization of bacteria which have metastasized there from the primary focus, or may be due to the localized action of toxins. The usual sites for focal infections, named in order of their frequency and pathogenicity, are the tonsils (and adenoids), the teeth, the nose, the prostate and seminal vesicles, the gall bladder, the gastrointestinal tract, the skin, and the lower respiratory tract. The tonsils and teeth, as sources of focal infection, are most commonly emphasized, and it should be remembered that they are usually silent—that they do not call attention to themselves by causing pain. The localization of the bacteria, or toxins, from the foci of infection upon the distant parts of the body, is considered by many workers to be *selective:* or in other words, certain strains of bacteria have selective chemical affinities for certain tissues, so that infection by a certain kind of streptococcus in a tonsil would cause a myositis in the shoulder, and infection by a different kind of streptococcus in the tonsil would, in metastasis, select the kidney. Another view is that the focus of infection throws out a shower of bacteria which light and cause inflammation in many different parts of the body: most of these heal or become quiescent, but in others the conditions for the growth of the particular organism involved are favorable, and disease, usually of a chronic inflammatory nature, progresses. It is possible that the focus of infection throws out its shower of bacteria into the circulation only once: for instance, an abscessed tooth causes an acute generalized toxemia which in the course of time subsides; it is debatable whether the infection in the tooth does not then become sterile; if so, the tooth is a focal source of infection only once. On the other hand it may remain infected

and reinfect the body over and over again, the bacteria (or toxins) naturally lighting on those spots which are already areas of inflammatory change produced by these same organisms. This is a very important point for therapeutic consideration. Failure to obtain relief after removal of focal infection may be due to the fact that the secondary infection has been set up and is active, and that the focus of infection removed is sterile. In subacute infections arthritis due to focal infection from the teeth or tonsils, the joints themselves may become foci of infection. Therapeutic failure may also, of course, be due to removal of the wrong focus of infection.

The pathologic changes which have been ascribed to focal infection are many. Myositis (i.e., muscular rheumatism, or myalgia due to inflammatory deposits and resulting synechia in the muscles); neuralgia and neuritis; acute, subacute and chronic arthritis; iritis; onychia; nephritis; myocarditis; endocarditis; aortitis; atheroma; gastric ulcer; thyroid activity; perinephritic abscess.

The evidence to prove the relationship between focal infection and the ultimate pathology is largely circumstantial. It consists first, in establishing the coexistent fact of the focal infection and the distant disease in the same body. Secondly, it consists in the clinical demonstration of the recession of the distant disease upon removal of the focus of infection. This latter is obviously an uncertain foundation to build much theory on as it involves the danger of the old "post hoc, propter hoc" principle in therapeutics, which is the cause of most medical heresies. Thirdly, it rests upon the experimental biological and pathological evidence of culturing the organisms from the infected focus, injecting them into an animal and reproducing the lesions which are found in the patient. This last evidence, which has now accumulated from various laboratories, is open to three criticisms:

1. The specificity of the infection has not been demonstrated beyond cavil: the bacteria, from an infected tooth say, are injected into a rabbit; they almost invariably produce multiple lesions in many organs. The physician then points to the myocardial degenerations in the rabbit as similar to those which were found in the patient, ignoring all the other lesions. The skeptics would like to see the bacteriologist receive an unknown culture, the rabbit injection be made, and then the bacteriologist announce, without previous consultation with the attending physician, what disease his patient had. To be sure it is true in the majority of cases of certain kinds (i.e., joint, muscle and iris diseases), the disease is somewhat overwhelmingly reproduced in the animal, but still the criticism has not been candidly met by the experimental research on focal infection.

2. There is absolutely no certain proof that the bacteria from a focus of infection actually get out into the blood stream. An infection around the root of a tooth produces an inflammatory reaction with a dense protective wall about it; an infection in a seminal vesicle is well bound inside the walls of the vesicle, but do these bacteria escape from such protective walls? We assume they do; it is probable they do, but we have not proved it.

3. Identification of bacteria in the ultimate lesions with the bacteria in the foci of infection has not been made.

Debatable as many of these points are, the evidence which we have on the subject is strongest in favor of a large group of diseases of the muscles, bones, joints and periarticular tissues being due to focal infections. These painful and crippling conditions (which often have hardly any physical signs) clear up quite promptly and reasonably completely with the removal of such foci of infection as can be found. A few notes particularly on the rarer forms of these infections are appended because the search for focal infection must not stop with the teeth and tonsils.

(1) *The tonsils* are very frequently infected. The physician should make sure when they are to be removed that all the lymphoid tissue in the back of the pharynx has been inspected.

(2) *The teeth* have been so under suspicion and such good methods of examining them are at hand that no comment is necessary.

(3) *The upper respiratory tract* does not often cause metastatic disease. Upper respiratory infection, however, does cause lower respiratory infection very frequently.

(4) *Lower respiratory system infection,* bronchiectasis, etc., can cause bony changes, as witness pulmonary hypertrophic osteoarthropathy.

(5) *Gall bladder infection.* I recently saw a patient demonstrated who before her gall bladder was removed had arthritis of the joints in her hands so badly that she several times begged her physician to cut off both her thumbs. A sudden attack of gall bladder colic indicated the seat of a focal infection and after cholecystectomy the arthritis of the finger joints subsided so that within six weeks she was performing many fine movements.

(6) *Intestinal infection.* The evidence of those who have made routine thorough stool examinations in cases of rheumatoid arthritis is too overwhelming to be disregarded. Barrow and Armstrong found in 245 cases of chronic deforming arthritis that 96 per cent of the patients were "colon conscious," or, in other words, knew there was or had been some digestive trouble. Under the habit of making repeated careful search for protozoa in the stools, they found 94 per cent of these cases to have some type of intestinal protozoan parasite. The ameba histolytica and

dysenteriae, Chilomastix, trichomonas, Giardia, and ameba coli, were the types most frequently found. An independent investigator, Wyckoff, as reported by Ely, conducted a less painstaking investigation, but found parasites in 38.9 per cent of the cases he examined. It is not supposed that these parasites actually localize and set up changes in the joints, but that metabolic and toxic changes are induced. The use of neoarsphenamine, which is so useful in chronic deforming arthritis, is beneficial possibly, as Kofoid says, because of its antiprotozoal qualities. The whole subject is worth pondering. Dr. Rea Smith, of Los Angeles, has for some years been removing the entire colon for chronic arthritis, sometimes with striking results.

(7) *Seminal vesicles.* Infection of the seminal vesicles may be due to other organisms than the gonococcus. Gonorrheal arthritis is, of course, the typical disease which exemplifies our present theme of joint disease due to focal infection. The seminal vesicles should, however, never be overlooked in a case of "lumbago" or chronic muscular or joint pain, when searching for foci of infection. Shea, in a valuable article, recites several cases of arthritis which got no better after teeth and tonsil removal, but which cleared up quickly after treatment of infected seminal vesicles. Backache, particularly, is associated with infection of the vesicles. This may be due to a reflex arc, or actually to absorbed products causing myositis or arthritis. The vesicles have a rich supply of sympathetic ganglia in the middle muscular coat, and their lymphatics drain into glands lying on the common iliac arteries. "This very likely accounts for the persistence with which arthritic conditions locate in the lower extremities, as well as the prominence of these joints as sites of predeliction," according to Shea. Treatment is by massage and stripping of the vesicle, vaccines, vesiculotomy and vesiculectomy.

**II. Diet.**—Two general views of the nature of the disease process in chronic arthritic and periarthritic structures have been maintained side by side. One is infection, the other is altered metabolism. They are not necessarily antagonistic, as metabolic changes can follow prolonged infection. Certainly in these patients, if the disease is of long standing, the whole body has a changed metabolism. The idea goes at least as far back as Haig with his uric acid diathesis, and few of these patients have escaped being forbidden to eat meats and proteins.

Pemberton has made particular studies of the metabolism of these patients. In arthritis there is a local as well as a systemic retardation of metabolism. The changes in the joints can be explained on the basis of chemical changes. The basal metabolism of such patients is about 20 per cent under normal; the quantity of creatinine in the blood is slightly increased; there is a tendency towards retention of salt and water. No change was found in the urea and nitrogen content of the blood. Pem-

berton advocates a general reduction in the caloric amount of the diet, reducing especially the carbohydrate and, because it is converted 50 per cent into carbohydrate, the protein. He furnishes a diet as follows:

*Breakfast*

| | | Calories |
|---|---|---|
| 1 apple | 150 gm. | 72 |
| 1 egg | 50 gm. | 83 |
| Bread | 60 gm. | 162 |
| Butter | 15 gm. | 120 |
| Sugar | 20 gm. | 80 |
| Milk | 60 c.c. | 39 |
| Coffee | | |

*Lunch*

| | | |
|---|---|---|
| Bouillon | 180 c.c. | |
| Lettuce | 40 gm. | |
| Mayonnaise | 1 tbsp. | 187 |
| String beans | 100 gm. | 17 |
| Bread | 30 gm. | 80 |
| Butter | 10 gm. | 80 |
| Orange | 250 gm. | 96 |
| 1 egg | 50 gm. | 83 |

*Supper*

| | | |
|---|---|---|
| Steak | 50 gm. | 143 |
| Bread | 60 gm. | 160 |
| Butter | 15 gm. | 120 |
| Tea | | |
| Sugar | 20 gm. | 80 |
| Milk | 60 c.c. | 39 |
| Beets | 100 gm. | 40 |
| Lettuce | 40 gm. | |
| French dressing | 2 tbsps. | 298 |
| 1 apple | 150 gm. | 72 |
| Total calories | | 2051 |

**III. Rest.**—Local rest for the painful inflamed member is an obvious method of relief. Yet how seldom practiced! How many times is the consultant asked to see a gonorrheal arthritis for which everything has been done except to put it in a splint! A very successful general practitioner of my acquaintance has a tremendous reputation in his community for the treatment of lumbago: and all he does is to put the patient in a plaster body cast.

**IV. Counterirritation by Heat, Water, Electricity, etc.**—This is probably the favorite method of treating chronic muscle and joint pains. The technic of various procedures is described elsewhere in this book. Simple baking by hot air, the use of hot water bags and electric pads, and all the refinements of hydrotherapeutic measures are employed. Diathermy is a form of heat and electricity probably more effective than any other method of producing heat. Nearly all watering places and

mineral springs treat "rheumatism" by their own methods, which are often very effective, probably because local treatment is combined with general metabolic management. The radio-activity of these waters makes them more valuable when used at the source, according to the statements of the physicians in attendance in these resorts. Litchfield is of the same opinion.

**V. Massage.**—In certain of these diseases carefully planned massage is of great value. Most of the cures of our brethren (perhaps I should say brethren-in-law) in the field of osteopathy and chiropractic are in this class of patients, and are achieved by using no very gentle or very scientific kind of massage and manipulation. I do not see why any qualified regular general practitioner cannot learn to perform this kind of therapy in a very short time.

**VI. Drugs.**—The salicylates are given to these patients in appalling amounts. They seldom do the slightest amount of good, even as pain killers. Cinchophen and neocinchophen are much more effective as analgesics and have a more logical rationale for etiologic reasons.

Arsenic is the best drug we have for the chronic joint diseases, particularly arthritis deformans or atrophic arthritis. Its action may be due partly to its general influence on metabolism: we have emphasized above the metabolic factor in the disease. It may, as was also suggested above, act as an antiprotozoan agent for the intestinal infections. Fowler's solution by mouth, or better, neoarsphenamine are both used. The dosage will depend upon the physician's judgment.

A drug recently introduced with which I have seen some striking results is amiodoxyl benzoate. Young and Youmans and Willard Smith have published reports listed in the references. Young and Youmans used the ammonium salt of ortho-iodoxy benzoic acid giving it by mouth in 1.5 gm. doses, or in smaller doses intravenously. Smith used amiodoxyl benzoate intravenously and felt that the by-effects of sweating and reaction were eliminated. The chief good effects were relief of pain and cessation of muscle spasm. The solution should not be heated above body temperature before administration and should be administered intravenously very slowly, preferably by gravity.

Iodide of potash has been used for a long time in these diseases often with good results.

**VII. Nonspecific Protein Therapy** is often of great value. Its principles are discussed in Chapter III, Part I.

**VIII. The General Metabolic Condition** has been attacked by radium emanations and the use of thyroid extract. Cecil has reported on a form of arthritis appearing at the menopause, for which ovarian therapy is theoretically applicable.

## References

Barrow and Armstrong: The Etiology and Pathology of Chronic Deforming Arthritis, Tr. Sec. on Path. and Physiol., Am. Med. Assn., 1926.

Cecil and Archer: Arthritis of the Menopause, Jour. Am. Med. Assn., January 10, 1925, lxxxiv, No. 2.

Collins: Observations on the Cast Treatment of Gonorrhoeal Arthritis, Jour. Am. Med. Assn., December 3, 1921, lxxvii, No. 23.

Pemberton: Further Observations on Arthritis and Rheumatoid Conditions, Am. Jour. Med. Sci., December, 1923, clxvi, No. 6.

Shea: The Seminal Vesicles in Arthritis, Jour. Am. Med. Assn., January 26, 1924, lxxxii, No. 4.

Smith, Willard: O-iodoxyl benzoic acid in Arthritis, Boston Med. and Surg. Jour., February 24, 1927, and March 31, 1927.

Straub: The Diagnosis of Conditions Causing Backache, Jour. Am. Med. Assn., March 10, 1923, lxxx, No. 10.

Young and Youmans: Jour. Am. Med. Assn., September 4, 1926, lxxxvii.

## CHAPTER XXV

## THE TREATMENT OF SOME COMMON NERVOUS DISORDERS

The opprobrium of neurology has always been the hopelessness of treatment. And it is, of course, true that once a nerve tract is destroyed, cell bodies and all, no regeneration occurs and nothing that we can do is likely to improve the condition. But there is a host of disorders commonly grouped under diseases of the nervous system—although many of them such as migraine, headache, the psychoneuroses and chorea are more likely to be general bodily derangements than strictly due to changes in the nervous system—which are quite as amenable to treatment as disease in any other part of the body. Furthermore they are not only frequently seen, but are far better treated by the general practitioner than by the strictly nervous disease specialist. A list of these I intend to discuss from the therapeutic standpoint. In doing so I shall make no attempt to give a digest of the classical literature on the subject, but shall put down the methods which have proved serviceable in my own hands. The disorders are grouped symptomatically rather than pathologically, as this offers the most logical method of approach, just as a similar plan did in our consideration of renal and cardiac failure.

### I. HEADACHE

Headache is classified by every one in a different fashion. In general, however, these classifications agree, that we should distinguish four divisions:

1. *Acute headaches* due to the prodromes of a fever—the classical headache of early smallpox, of meningitis, of minor infections, of toxemia and fatigue.

2. *Headaches due to organic disease,* such as brain tumor and uremia.

3. *Reflex headaches* from eye strain, nasal sinus infection, teeth infection, etc.

4. *Idiopathic chronic headaches.*

The last class is the great bugbear of practice. People with chronic headache seem to be mysteries to all the many physicians they visit. Most of them have had glasses fitted, and nasal operations performed without relief. In spite of the enormous literature which the ophthalmologists and rhinologists have produced, I am sure that very few chronic headaches are due to either eye strain or nasal disease. In fact

the great majority (75 per cent) of chronic headaches are due to one of two causes—migraine or neurosis.

I recently asked in a dispensary clinic to have all chronic headaches referred to me for study. I examined a hundred of these patients and unearthed some very interesting things. Headaches due to brain tumor, prodromes of infection, etc., were by the nature of the case ruled out. By all odds the largest single number of cases I had were cases of migraine (51 per cent). Many of these were so masked, were such irregular forms of migraine, that it took a long time to unravel the history and make the diagnosis. Most of them had had glasses fitted without relief to the headache. In fact very few of my patients could be said to have headaches due to eye strain. I found that oculists and rhinologists took almost no histories on the headache patients sent them. The usual procedure was to write down "headache" on the chart, ask no further questions, and proceed to test the eyes or examine the nose. Almost invariably an ocular defect was found, glasses prescribed, and the case classified as an ocular headache. The same case might be found to have a sinus infection or deviated septum and be classified as a nasal headache. I found headache cases galore which had both glasses and nasal operations, but still continued to have the headaches. I have learned to stop sending patients to oculists with the note "Headache" on their reference cards. If I did that the patient invariably got glasses. If I wrote on the card—"Smith"—(a rival oculist)—"thinks this patient needs glasses, but I do not agree with him. What do you think?"—then, in four cases out of five, the answer came back—"Does not need glasses at all," and in the fifth case glasses were needed, but not the kind Smith had prescribed.

The main causes of chronic headache in my series were migraine (51 per cent), neurosis (21 per cent), hypertensive cardiovascular disease (8 per cent), eye strain (11 per cent), neurosyphilis (3 per cent) and miscellaneous causes, nasal disease, endocrine disease, etc. (6 per cent).

**Certain clinical features of migraine** should be noted. It can be treated, and if it is to be treated, the physician must be able to recognize it. There is no use calling such headaches eye strain headaches and fitting glasses, because, all the massed authority to the contrary, this does no good. Migraine must be recognized entirely through taking a good history.

The most serious mistake which is made about the disease is to consider it as a psychoneurosis. The lack of anatomical change in the body of a patient with migraine has led many excellent people into this error. Migraine is a perfectly definite disease entity which afflicts all kinds of individuals, some of them hysterical, but most of them otherwise quite normal. We may not know very much about its pathologic

physiology, but we know a great deal about it descriptively. In this connection it is interesting to note that the victim usually refers to it as "my headache." He or she may have other headaches, but they are not the same. The victim recognizes the difference, and knows that the migraine is a distinct entity.

For descriptive purposes then, it may be called a periodical sensory discharge, just as epilepsy is a periodical motor discharge (and no one doubts that epilepsy is a definite disease, although we can find no tissue pathology or pathologic chemistry to account for it, any more than we can in migraine). Migraine is a periodical sensory discharge accompanied by a temporary loss of muscular tone throughout the entire gastrointestinal tract. Vomiting often and nausea nearly always accompanies the attack. Thus it is called "*sick* headache." These gastrointestinal symptoms may overshadow the headache itself so that the patient says, "I have always been subject to bilious spells." "Biliousness" is another thing that is scorned by the present generation of physicians, trained in the physiological, bacteriological, chemical and serological laboratories. Of course, it literally means getting too full of bile and, of course, again, that does not happen. But what do these people mean when they say they are "bilious"? They must mean something; they must be naming some general bodily sensations. They mean, I take it, that they feel as if their stomach and bowels were at a standstill, that they are full of some toxemia (they think it is bile) and are consequently headachy and nauseated and constipated and want to lie down. When they finally vomit, as they usually do, they vomit pure bile as they repeatedly tell you; that is, the pyloric sphincter has been standing open and the bile in the duodenum has made its way into the stomach. There may be an actual reverse peristalsis, such as is described by Alvarez. After the bile is vomited, the attack often begins to abate, because the normal gastrointestinal tone is returning. But it is perfectly natural for a patient who has been sick and has vomited bile and then begun to get better to ascribe his trouble to being "bilious."

Its hereditary nature can nearly always be traced in the history, and is an important point to develop for its diagnostic significance. In 18 out of 110 cases Kovalevsky was able to trace it through three generations and Wills in one case could trace it through five generations.

The aurae are not always easily recognized as such, even by the patient. The classical zig-zag eye flashes are the exception, as well as the temporary aphasias of Livering. Oftenest the aura will be some peculiar bodily state such as euphoria, or a sound night's sleep, chills, general gastrointestinal distress, general depression or fatigue. Some patients report that such things as sexual overindulgence, bad air in the bedroom, or a long stay in any close room, an indiscretion in diet, will bring on

an attack. Sudden changes in weather, a thunderstorm, or damp atmosphere are also put down as causes. The onset of the menses often brings on an attack, while pregnancy during its period almost invariably brings relief.

The age onset of migraine in the individual is variable. It almost never appears in childhood, but begins usually at adolescence and is at its greatest severity during adult life. After the menopause the attacks as a rule cease or mitigate their severity. Women are victims of the disease three times as frequently as men.

To summarize, we must conceive of migraine as a perfectly definite disease entity having its manifestations on the physiologic rather than the anatomic side—the diagnosis to be made on symptoms rather than signs. The important features in the history are headaches accompanied by a general bodily state in which the gastrointestinal symptoms are prominent, especially a feeling of paralysis and motionlessness of the bowel, with vomiting and particularly vomiting of bile towards the end of the attack. This bodily condition is *periodical*—a most important fact to elicit. The hereditary nature of the complaint, the existence of aura, and the association with the sexual cycle are important elements.

Treatment of migraine will perforce take into account some of the physiologic explanations which have been advanced to account for it. Endocrinologists have brought forward a number of suggestions. The association of the attacks with ovarian and sexual cycles is suggestive, but only for the female patients. Timme notices also hyperthyroid, gonadal, thymic and adrenal changes, and, since all these depend upon the hypophysis, he suggests that migraine is due to a pituitary and sella turcica disproportion, or, in other words, that the hypophysis in migraine individuals swells periodically causing the headache by pressure on too small a sella. Of course, such theories even if proved would only push the mystery somewhat further back, as the next logical question would be what hereditary element causes the hypophysis to swell periodically. Nevertheless these physiologic attempts at explanation are of value. It is but a step from the idea of endocrine imbalance to the idea of vegetative nervous imbalance due to endocrine influence. Schlesinger advised calcium glycerophosphate (along with ferri protoxalat oxydulat and ext. gentian) grains 10 by mouth three times a day. Calcium has well-known actions on the vegetative nervous system.

Vasomotor changes—dilatation of the vessels on the affected side of the head, even observations of unilateral dilatation of the retinal vessels—have led to a host of theories. Spitzer, thus, suggests that abnormal narrowness of the foramen of Monro in these individuals may lead to its occlusion when swelling of the vessels occurs, thus increasing pressure in the ventricles and causing headaches.

The gastrointestinal symptoms have given rise to several theories. Hartsock has shown by x-ray and other means a stasis of the duodenum and upper intestinal tract during the attack of headache. Treatment by duodenal drainage (Lyon) and saline and mercury flushing of the duodenum is recommended. This condition of stasis, however, has long been known and the feeling is familiar to all sufferers with the disease. A fair proportion of them know that if they get a cathartic, or some analgesic drug such as aspirin, in the stomach during the prodromal stage they may abort an attack, but if they wait until the attack is in full swing, any medicine which is swallowed will stay in the stomach and later be vomited. Translating these clinical facts into physiologic language, it means that if the drug is taken before the gastrointestinal stasis occurs, then it will be moved into the intestines and absorbed and thus have some action, but if taken later when the gastric and intestinal musculature is paralyzed, no absorption occurs.

Liver dysfunction has been found by Diamond, consisting of latent icterus with bilirubin retention, and increased urobilinogen. Treatment by abstinence from animal protein, changing the intestinal flora and relief from spastic constipation is recommended.

A much more fundamental idea of etiology is that which considers migraine to be a somewhat atypical form of allergy. The hereditary character, the eosinophilia and the response to protein therapy all dispose towards this idea.

The symptomatic treatment of the disease brings up a host of remedies. Cannibis indica (1/5 grain of the extract) and Tr. Gelsemium in doses sufficient to get the physiologic effect are old favorites. Daily doses of luminal, much as it is administered in epilepsy but in smaller doses, may be given to patients who have frequent attacks.

The fact that the disease often ceases after the menopause has led to exposure to radium or x-ray over the ovarian region for temporary sterilization. Obviously these cases must be carefully selected.

**Peptone for Migraine.**—Following some reports by Pagniez, Vallery-Radot, and Nast, and an interesting theory of Abel's, Miller and Raulston treated twenty-five cases of migraine with the injection of peptone. The French students used horse serum intravenously, later substituting peptone, with the idea that migraine is an anaphylactic phenomenon. The similar hereditary nature of hay fever and animal-dandruff sensitiveness and the occurrence of eosinophilia in both conditions gives some support to this idea. Abel's experiments were done with placental extract, because he based his treatment on the observation, recorded above, that patients with migraine are usually free from attacks during pregnancy. Abel was of the opinion that the placental extract exercised some obscure endocrine effect, but it probably acted merely as a nonspe-

cific protein, the idea that migraine is an endocrine disorder, associated with placenta secretion being vitiated by the fact that men have migraine. Ball has recently adduced interesting evidence to indicate that migraine is a sensitization disease. For instance, migraine was found associated with asthma in 22 per cent of some selected case histories, with hay fever in 13 per cent, and with urticaria in 28 per cent.

In treating migraine with peptone, an initial dose of 5 minims of Armour's 5 per cent peptone solution is given intravenously. This is followed every three or four days by repeated injections, increasing the amount of the peptone solution 5 minims each dose until maximum doses of 25 minims are reached. Successive injections at the same intervals are kept at that dose. If no benefit results after ten injections, the treatment may be stopped. Ball reports failure in 50 per cent of all cases treated, and marked improvement in 35 per cent.

There is no question as to the efficacy of the treatment in certain cases. After a series of injections patients with migraine may go a year without an attack, finding relief again after a second treatment series. There is no way of telling which patient will be benefited, just as there is no way of predicting which hay fever patient will get relief.

**Treatment of Other Forms of Headache** mentioned above is dependent upon the cause. The neurotic headache will be treated in every case as as individual problem. The great danger of this class is that some queer physiologic or faddist explanation will be hung on the case and treatment carried on along those lines. The patients almost invariably have a long record of attendance upon oculists, rhinologists, endocrinologists, physiotherapists, gynecologists, gastrologists, duodenologists, masseurs, soul clinics, Indian swami, fake electrical quacks, and similar gentry. The headache is invariably regarded as very, very mysterious.

Sluder's "lower half headache" is really a neuralgia due to involvement of the sphenopalatine ganglion. The pain is over the cheeks and in the superior maxillary region with radiation into the neck and shoulder. Injection of alcohol and phenol into the sphenopalatine ganglion has afforded relief in Sluder's hands.

One form of headache is now mentioned in every discussion of the subject and some notice of it will be expected. This is the headache described by certain German clinicians, and known variously as "indurative headache," "nodular (rheumatic) headache." Unless I say something about it, it will be assumed that I never heard of it, though my first acquaintance with it dates from reading the article on headache by Edinger in "Der Deutcher Klinik" about 1907. I was interested to find Dr. Hugh Patrick analyzing it in 1918, and even more amused to read in the discussion that followed his paper the report of a physician who stated that he was a living example of indurative headache, and then

went on to describe his headache in a way which might almost be put into a textbook as a classical description of migraine. I no longer can recognize any indurative headaches. All the ones I see labelled that way are either migraine or neurosis. The indurative or nodular headache is supposed to be due to spots of induration in the muscles or fascia of the neck. The detection of these indurative spots varies directly with the susceptibility of the diagnostician; if he believes in them and expects to find them, he finds them; if he does not believe in them, he cannot find them. The treatment prescribed for them is massage. This treatment benefits the patients with psychoneurotic headache, because it is highly suggestive. The physician explains that the headache is due to nodules in the neck and that he intends to rub these nodules away. He proceeds to rub, the patient, as is evident, being under the strongest suggestive influence as he does so.

For the general treatment of headache in such cases as cannot easily be resolved by diagnostic measures, besides the ordinarily used means of analgesic coal tar drugs and catharsis, two simple methods have been recommended—one by the use of sodium chloride and one by magnesium sulphate. The general assumption that intracranial tension is the physiologic condition in headache is behind both methods. The sodium chloride treatment as practiced by Hughson is based upon the demonstration by Weed and McKibben, that the pressure of the cerebrospinal fluid can be much reduced by intravenous injections of concentrated solutions of common sodium salts. and that of Cushing and Foley that similar reductions can be obtained by the simple alimentary ingestion of strongly hypertonic solutions. Hughson got around the difficulty of having patients suffering with headache vomit crystalline sodium chloride by administering 1 gram (15 grains) salol coated sodium chloride tablets. Two to three tablets should be given every five minutes until eight or ten have been taken. Give as little water as possible.

Magnesium sulphate, as given by Fay for intracranial pressure conditions such as even skull fracture, is given 1½ ounces of the crystalline drug in 5 ounces of water by mouth or, if stupor or coma is present, 3 ounces of the crystals in 6 ounces of warm water by rectum.

## II. NEURALGIAS

The general treatment of the neuralgias comprises:

1. *Removal of foci of infection.*
2. *Application of heat* in the form of electric pads, hydrotherapy, electrotherapy or warm air bakes.
3. Massage in proper cases (only when it gives relief).
4. Analgesic drugs.

The discussion of these things under the chapter on Diseases of Locomotion will apply here.

## Special Forms of Neuralgia

**A. Tic Douloureux:** By H. P. Kuhn, M.D.

**Diagnosis.**—The diagnosis of tic douloureux is made upon the presence of short attacks of excruciating pain radiating over the distribution of one or more branches of the fifth nerve. These attacks of pain rarely occur in an individual under fifty years of age and in about 50 per cent of the cases, there is some evidence of deafness. Rarely do these attacks occur at night; once the patient having gotten to sleep, unless awakened by something stimulating the genetic point which is present in a fairly large percentage of cases, he will go through the night with comfort. The onset of the pain is sudden, persists from one to thirty seconds usually and at its completion the patient is comfortable. In about half the cases there is a history of the provocation of the attack by the stimulation or irritation of some genetic center. This has been referred to as the trigger point. It may be the ala of the nose, a tooth, the side of the tongue or a point on the lip. These points having been stimulated by a breath of cold air, taking food, or by touching, the patient immediately has a spasm of pain. Sometimes these attacks of pain are preceded by an aura, giving rise to the statement that tic douloureux is an epilepsy of the trigeminal nerve. It has been said that if a diagnosis of tic douloureux cannot be made in thirty seconds, it is not tic douloureux. The symptoms, type of pain and its distribution are invariably characteristic. The only symptoms comparable and similar to these are in Sluder's neuralgia, where the onset of pain is not so sharp, is more constant and is referred usually to the nose or to the mastoid region, and frequently depends upon a chronic nasal disease as its causative factor.

**Treatment.**—The drug treatment of tic douloureux has largely been given up. A number of years ago castor oil, in small doses over a long period of time, was thought to lessen the number of attacks. Bromides and nerve depressants are of little avail. Morphine, hypodermically, usually exerts its effect after the pain has stopped. The protection of the face from cold drafts and irritating influences, protecting the trigger point, in other words, will some times prevent the onset of the spasm. These patients learn tricks to avoid the spasm, such as taking food in one side of the mouth, protecting the genetic center in the tongue, etc.

The removal of possible foci of infection is indicated though practically all of these patients who have had the disease for any length of

time usually have had all of their teeth removed whether dead or not, some misguided dentist usually thinking that the pain is due to an exposed pulp or something depending upon the teeth.

The injection treatment offers temporary and sometimes permanent relief. The injection of the nerve at its exit from the face, the supra-

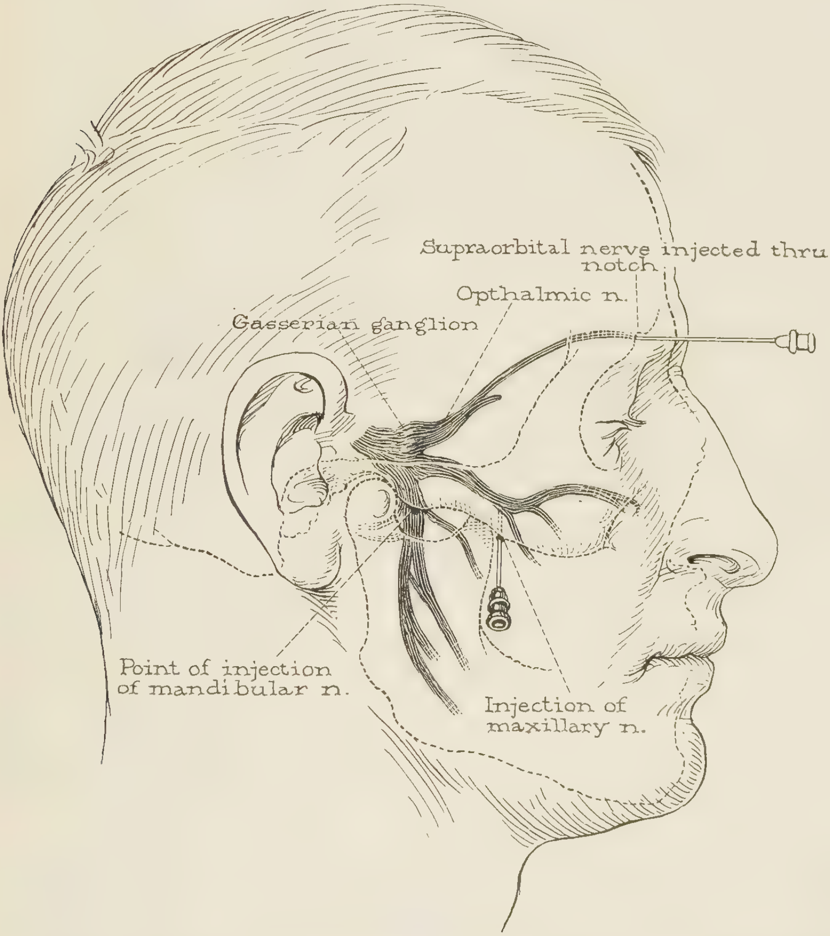



Fig. 93.—Sites for injection of various branches of trigeminal nerve for palliative treatment of tic. Middle branch is reached by inserting needle at a point at the lower border of the zygoma, 0.5 cm. behind a perpendicular let fall from the posterior edge of the orbital process of the malar bone. The needle engages the nerve as it emerges from the foramen rotundum. Inferior branch is reached by inserting the needle at the lower border of the zygoma, 2.5 cm. in front of the anterior root of the zygoma.

orbital notch, the infraorbital foramen and the mental foramen, with an anesthetic solution such as novocaine and 70 per cent alcohol, or Patrick's Solution (alcohol 13.5 c.c., cocaine muriat 0.1 gm., and aqua dest. q.s. ad. 15.5 c.c.) into the nerve at its exit, producing an anesthesia over

the distribution of the superficial branches, effects immediate results. This is brought about probably by the anesthesia of the genetic center in a certain percentage of cases. Failing this, or on a recurrence of the attack of pain, the injection of the nerve at its exit from the foramina of the skull should be undertaken. Injection of the supraorbital branch is very unsatisfactory as well as dangerous. Fortunately the supraorbital branch is not often affected alone, and if so all the other branches are affected with it. The maxillary branch coming through the foramen rotundum is fairly easily reached by the use of the Levy Baudouin needle at the depth of 5 cm. The injection of the mandibular branch at its exit through the foramen ovale is usually reached at a depth of 4 cm. The technic is simple. The instruments required are a 2 c.c. glass syringe and the Levy Baudouin needle graduated in cm. I find it easier to anesthetize the point of entrance in the skin with a little novocaine and with a sharp bistoury make an incision just large enough to admit the needle through the skin, about $\frac{1}{16}$ of an inch long. Bringing the needle backward from the site of injection to the proper depth, one encounters the bony cranium. By carefully feeling in the general direction of the foramen, one strikes the nerve. Immediately the patient has a spasm of pain over the distribution of that branch. At this point a little novocaine can be injected into the nerve sheath; following it the cannula is forced into the nerve bundle and one and one-half c.c. of Patrick's solution slowly injected, infiltrating the nerve sheath. If the procedure has been succesful, there will be immediate anesthesia over the distribution of the nerve. This anesthesia will persist for a few hours, after which there should be relief of pain. On removal of the obturator there should be no hemorrhage from the needle. If this occurs, the obturator should be replaced and further attempt to strike the nerve made. Some operators use absolute alcohol for their injection, claiming that they have more permanence of result. The objection to absolute alcohol rests in the fact that it hardens the tissues so that subsequent injections are very difficult.

While the injection of the nerve itself offers a symptomatic cure in a certain percentage of cases, it should always be used as a palliative method preparing the patient for the posterior root resection which will come later. These patients are often much impoverished in health and strength, unable to take food with comfort, and offer poor operative risks.

**B. Sciatica.**—The proper selection of cases of sciatica for medical treatment involves determining whether the pain along the sciatic nerve is due to—(a) sacroiliac arthritis or luxation, (b) spondylitis deformans, (c) disease of the hip joints, (d) pelvic neoplasms, (e) pelvic inflammation. Most students of the condition are of the opinion that the major-

ity of cases will come under one of these heads. The treatment is obviously orthopedic or surgical. Rogers goes so far as to say that there is no idiopathic sciatica. Whether there is or not, relief of the condition may frequently be accomplished by methods of treatment which are symptomatic and carry no burden of etiologic theory.

Removal of foci of infection, rest, splinting and heat are obvious general measures.

Injection of the nerve with one ounce of 1 per cent quinine urea hydrochloride has met with success in at least 30 per cent of these cases. The technic is given by Hertzler as follows:

1. Get ready a No. 18 needle five inches long, a syringe, an ounce of sterile 1 per cent quinine urea hydrochloride solution, some iodine, novocaine, and a second syringe.

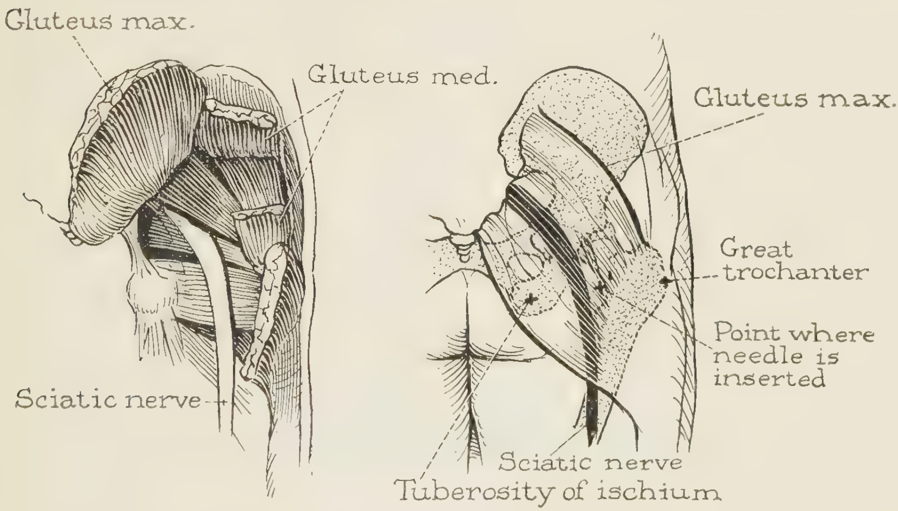



Fig. 94.—Clinical anatomy of the sciatic nerve, showing point at which introduction of the needle must be made in order to inject the sciatic nerve for sciatica.

2. The patient is put on a table lying on the side opposite to the sciatica. The affected leg is flexed on the abdomen, stretching the gluteal region taut.

3. A line is drawn from the great trochanter of the femur to the tuberosity of the ischium. A point one-third the distance from the tuberosity along this line is selected for the injection. Other practitioners use a point half way between the two landmarks.

4. After skin sterilization and anesthetizing, the long 18 gauge needle is passed in until the nerve is encountered. This is signalized to the patient by intense pain along the course of the sciatic nerve.

5. After the nerve has been entered the 1 per cent urea quinine solution is injected. An ounce is sufficient and not too much.

6. This may have to be repeated once a week for two or three injections.

The injection of the epidural space as practiced by Cathelin consists in injections of 60 to 80 cc.. of warm physiologic salt solution into the hiatus sacralis (of the sacrum). A study of an anatomic preparation or chart will make the technic clear. The patient had usually best be in the knee-chest position. A needle long enough to reach to about the second sacral vertebra is desirable. There is little danger of entering the subarachnoid space because the dura ends usually at the level of the first sacral vertebra: however, to be certain the needle should be left in a moment before the injection is begun to see whether there is any

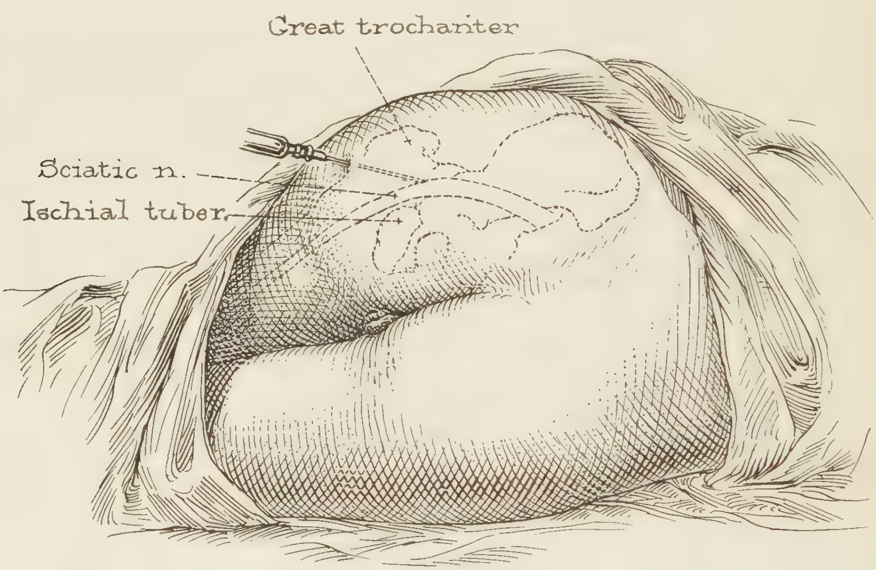



Fig. 95.—Position of patient for injection of sciatic nerve. Lying on side with leg of affected side flexed on abdomen. Needle is inserted at point half way between extreme outer point of great trochanter of femur and inner point of tuberosity of ischium.

escape of cerebrospinal fluid. If true sciatica is present, pain on the affected side is in progress followed by relief after the injection is finished.

## III. DIZZINESS OR VERTIGO

Dizziness is a symptom of disorder of the semicircular canals or of the vestibular branch of the eighth nerve or its central connections. Much confusion arises from considering vertigo as originating from the gastrointestinal canal as many patients, and even their medical attendants, do (viz., "I ate something which did not agree with me and I'm

dizzy," or "If I could just get my bowels regulated I would not be dizzy all the time," etc.). Dizziness is just as much a disorder of the semicircular canals and the vestibular tract as blindness is a disorder of the eyes. The semicircular canals have connections through the cerebellum with the vomiting center, the visual centers and the organs of locomotion: hence nausea, vomiting, inability to visualize connectedly and reeling movements may accompany vertigo.

The causes of vertigo are:

1. **Overactivity.**—Overwork of the semicircular canals. The classical examples are sea-sickness and car-sickness. They are due to such violent, rapid or repeated changes of position of the fluid in the canals that the receiving apparatus cannot keep up with the multitude of stimuli.

2. **Toxemias,** affecting the vestibular mucosa. Drunkenness is an outstanding example. But toxemias from infection or intestinal fermentation are frequent causes. Thus *constipation* finds here one of its few real symptoms.

3. **Reflex.**—Uncompensated visual defects can cause vertigo probably through the cerebellar associations.

4. **Focal Infections.**—One of the two most frequent causes of so-called Meniere's disease is focal infection. Teeth and tonsils are the usual sites. The ultimate pathology is unknown. Dr. Duel believes it to be a neuritis of the vestibular branch of the eighth nerve. This is logical in the light of our knowledge of focal infections and their predilection for lighting upon nerves. If a focal infection lights upon a sensory nerve the sensation produced will be pain: but the vestibular nerve carries no pain impulses, only sensations of equilibrium: therefore when a focal infection lights upon it, the disturbance will be only in the field of its own sensation, resulting in vertigo.

5. **Arteriosclerosis** is the second most frequent cause of chronic and recurring vertigo. Whether the lesion localize in the labyrinth, or nerve, or ganglia cannot be said with certainty—perhaps in any of these spots.

6. **Syphilis.**—A luetic labyrinthinitis undoubtedly occurs. All patients with chronic vertigo should have a Wassermann test before treatment of any kind is undertaken.

7. **Middle ear disease** when it becomes chronic affects the labyrinth.

8. **Neoplasms or gummata** of the brain or meninges in the path of the eighth nerve cause rapidly increasing vertigo. A tumor of the cerebello-pontine-angle or eighth nerve tumor is the most frequent form of brain tumor.

Treatment of vertigo will depend upon the cause. Iodide of potash in rather small doses (10 drops of the saturated solution three times a day) is the most reliable drug in the arteriosclerotic form. It is also useful to help restoration after removal of focal infections.

## IV. CONVULSIONS

Aside from the convulsions of infancy, the commonest causes of generalized convulsions met in clinical practice are epilepsy, hysteria, eclampsia, uremia, general paresis in certain forms of onset, and more rarely meningitis. The treatment of hysterical convulsions is that of the underlying neurosis. The treatments of paresis, uremia, and meningitis are dealt with elsewhere in this book.

### A. Epilepsy

The treatment of epilepsy demands first the determination of whether the patient shall be put in an institution or not, a decision which is dependent largely on the mental status.

The general habits and occupations of the epileptic need supervision. Out-of-door manual labor is perhaps the safest general rule. Occupation away from fires, hot objects, pointed objects, anything which can injure the patient when he falls in a fit, must be chosen. Frequent bathing is to be advised to prevent bromism, provided the patient is taking bromides.

The two drugs for chronic administration are bromides and luminal. Both are described in detail in the chapter on Drugs. Some clinicians prefer to administer the three bromides together—the sodium, potassium and ammonium salts—and claim better results than with any one alone. It is generally advised that even if the convulsions cease, an epileptic should continue to take bromides for at least two years after the last convulsion. They should never be stopped suddenly, but be reduced a grain at a time. Continuous bromide administration should be accompanied by continuous sodium chloride administration. Bromides and iodides hasten the elimination of chlorides from the body, thus upsetting the normal chemical ion balance. The action of bromides is dependent upon the bromide saturation of the body and this depends upon the relative amount of chlorides ingested. The routine administration of 3 to 5 grains of sodium bromide is based upon a sodium chloride ingestion of 15 grams.

Luminal acts best in grand-mal attacks or petit-mal attacks. The dose, which varies from 1 to 2 grains, is given at bedtime. The patients in whom it is successful are in much better mental health (free from torpor and stupor) than those who take the bromides.

**Diet in Epilepsy.**—In 1921 Geyelin reported that attacks of epilepsy were prevented by prolonged fasting. Such a treatment is naturally not applicable to a life-long disease, but it was found by Wilder that the results were probably due to a ketonemia because when a high fat diet sufficient to produce acetone and diacetic acid in the urine was used the results were almost equally good as in fasting. Peterman describes the diet as follows:

"Every patient treated with the diet is given an individual prescription. The basal metabolic requirement is determined directly or calculated from the Du Bois normal standards. Thirty per cent is added to the basal food requirements for growth and energy. This caloric allowance will depend on the age, weight and height of the patient, and will approximate 77 calories for each kilogram. Overweight patients are kept within their basal food requirements until their weight is reduced to approximately normal. After a few days of gradual carbohydrate restriction, 50, 40 or 20 gm. daily, with increasing allowances of fat, 70, 90 or 100 gm. daily, the patient is put on his individual prescription, which consists of from 10 to 15 gm. of carbohydrate daily, 1 gm. of protein for every kilogram of body weight, and sufficient fat to supply the remaining caloric allowance. Provision is made for the vitamins and salts. Water is allowed freely.

"This diet is not well tolerated if started abruptly, but if started gradually there is little difficulty and the patients consume relatively large amounts of fat, with zeal. A good morale can be developed in the patient, with resulting cooperation which plays no small part in the successful treatment of epilepsy. Except in certain cases, the patients are not restricted in their daily routine."

In thirty-seven patients, most of them children, observed for from three to thirty months, nineteen became entirely free from attacks on no other treatment than the diet.

*Nonspecific protein therapy* has been used based upon certain clinically observed facts, one that an epileptic became free of attacks after a rattlesnake bite. Thus snake venom was used by Spangler. Wilder has recommended the use of peptone. The general technic is the same as its administration in migraine.

### B. Eclampsia

The treatment of eclampsia has come to be markedly influenced by the method of Stroganoff. This is essentially a realization that the highly excitable nervous system, the convulsions, not the fetus in utero, is the point of attack. The internist only occasionally is called in consultation in such cases, but when he is I feel that the repressive measures of Stroganoff should be urged until further experience gives us something

better. These consist in large repeated doses of morphine and chloral. Morphine gr. ¼ to ½ is given immediately, two hours later 20-40 grains of chloral by mouth or rectum, two hours later a repetition of the morphine, and two hours later a repetition of the chloral. Meddlesome attempts at elimination by catharsis, sweating, etc., are forbidden. Venesection of 600-700 c.c. of blood is sufficient. The uterus will usually go into labor when eclamptic convulsions begin. If not, at the end of six to eight hours of the above treatment, labor is induced. The patient is kept in a quiet dark room and no visitors are allowed.

## V. TREMORS

Tremulousness is due to many infections, intoxications, and mental states. Tremor may also be. The most important tremors which are grossly pathologic are those due to Sydenham's chorea, Parkinson's disease, and as a sequel of epidemic encephalitis.

Chorea of the Syndenham variety is almost certainly infectious in nature, its association being with tonsillitis, rheumatism, endocarditis, myocarditis and pericarditis. Removal of suspicious tonsils should be instituted after an attack.

Treatment is by rest, isolation, and the use of either arsenic or the salicylates. Fowler's solution is the ancient standby for the treatment of chorea. For a child of about eight years of age 4 to 5 drops of the solution three times a day after each meal and increased one drop per dose a day until 12 to 15 drops are being taken three times a day. Toxic symptoms such as nausea, puffiness under the eyelids, or neuralgic pain, indicate withdrawal.

Neither the auto serum method of Goodman, nor any of the vaccines or endocrine treatments can be recommended. Lumbar puncture has been used with reported success. The spinal fluid was under high pressure.

Paralysis agitans and the dyskinesia of encephalitis are both probably due to lesions in the corpora striata. The only treatment which has ever benefited them is hypodermic injections of hyoscine. It should be administered in fairly large doses. After an initial dosage of $\frac{1}{150}$ grain twice a day, watching the effects, the amount may be raised to $\frac{1}{96}$ twice a day, and even more if no untoward effects are observed. Glandular treatments with parathyroid hormone and calcium lactate have been tried, as well as pituitary extract.

## VI. COMMON FORMS OF PARALYSIS

1. **Ocular Palsy.**—Paralysis of the eyelid, or the muscles moving the eyeball, involving the third, fourth, and sixth cranial nerves, is almost invariably due to syphilis. Antiluetic treatment should be instituted.

A long experience with students and internes has taught me that it is proper to make the specific suggestion that iodide of potash should be pushed, to the subordination of arsenic and mercury. Large doses of iodides must be given and results are often not obtained for nine to twelve weeks.

2. **Facial Paralysis. Seventh Nerve Paralysis. Bell's Palsy.**—The commonest form of this is a recurrent paralysis of one side of the face, for which no cause is known. It comes on suddenly, often with a history of exposure to cold; it lasts for several weeks and gradually clears up, to recur. Treatment consists in the use of the galvanic current to keep up the nutrition of the muscles, and iodide of potash. Often the disease is syphilitic.

When ear disease or mastoid operation is the cause of the paralysis, treatment is usually futile.

3. **Multiple neuritis** may be due to lead, alcohol, arsenic, infection, or may occur without known etiology. Treatment consists in:

a. Rest in bed until the acute stage has subsided.

b. Elimination of the etiologic agent. For lead poisoning, iodide of potash or calcium; for arsenic, sodium thiosulphate. For alcohol, removal of its use.

c. High caloric diet.

d. Galvanic electricity.

e. Massage and hydrotherapy.

f. Tonics, such as strychnine.

g. Psychotherapy.

4. **Hemiplegia. Cerebral Apoplexy. Cerebral Thrombosis.**—Treatment in the acute period:

a. If the patient has been stricken while about his vocation or avocation, as usually is the case, he should be conveyed home, the clothing removed, cut off, if necessary, and the patient put in bed.

b. Venesection should nearly always be done.

c. Lumbar puncture and removal of some spinal fluid must be considered. The fluid is usually bloody.

d. Ice bag to the head.

e. Empty the bowel by enema.

f. Empty the bladder by catheter.

g. When the patient returns to consciousness, the diet must for several days be very light; entirely milk is best.

h. Circulatory support by caffeine, camphor, strychnine, etc.

After the acute stage is over, the hemiplegic state must be treated by massage, exercise, re-education, and general treatment of the underlying circulatory condition.

## VII. NEUROSYPHILIS

The value of different treatments for neurosyphilis has been put upon a much firmer basis since the publication of the reports of Fordyce, Stokes and Shaffer, and Moore. Altogether we have, from these three reports, data upon the results of treatment in 1108 cases of neurosyphilis.

The type of case is of the utmost importance in determining the kind of treatment to be given. In general all the observers mentioned agree upon four classes:

1. Purely meningeal neurosyphilis. An early manifestation, often asymptomatic, or acute syphilitic meningitis, or recurrences. Treatment should be by routine arsphenamine—(or neoarsphenamine, though Stokes says neo is only a tonic in neurosyphilis and advises arsphenamine), mercury, bismuth and iodide of potash. Intensive treatment—more arsphenamine, longer courses, and shorter intervals between doses—may have to be employed.

85 per cent good clinical results.
60 per cent good serologic results.

2. Neurosyphilis with predominant meningeal or vascular involvement or both, sometimes with, sometimes without, parenchymatous changes. Transverse myelitis, hemiplegia, syphilitic epilepsy, brain gumma, etc.

Treatment by intensive arsphenamine, mercury and iodide of potash, or bismuth courses. Treatment should be continued over two years. Intraspinal treatment is used in resistant cases, or according to Moore, better results are obtained with tryparsamid or malaria treatment. Good clinical results in 76 per cent of cases; good serologic results in 59 per cent.

3. Parenchymatous neurosyphilis, including tabes and general paresis. Tryparsamid injections intravenously, or malarial inoculations, or other infectious disease methods of treatment are preferred in paresis. In tabes intraspinal injections by the Swift-Ellis technic is by all odds the treatment of choice. In tabes from 40 per cent to 50 per cent good clinical results and about the same good serologic results, though in only about 30 per cent of cases good combined results can be expected. In paresis 57 per cent good clinical, 31 per cent excellent or good serologic results, and 28 per cent good combined results are reported by Moore.

4. Optic atrophy, present or advancing, should not preclude the use of arsenical treatment intravenously, and more especially intraspinally. Fordyce reports 55 per cent good results in such cases. Intraventricular tap and bichloride of mercury injections in the ventricle have been recommended for optic atrophy.

## VIII. THE PSYCHONEUROSES

The hope of medicine in dealing adequately with the psychoneuroses is the general practitioner. In order to realize this hope we want him first to recognize them, second to understand them, and third to treat them by psychotherapy himself if he will or if not to encourage some one in his community so to treat them. Of these troubles the most pressing today is for understanding. It is not surprising that the general practitioner does not understand them. He seldom sees any or has any explained to him while he is in medical school. In medical school he is shown intricate mechanical or chemical problems as subjects of study. He leaves school with the idea that all disease can be reduced to mutations of protoplasm in terms of chemical, physiological or anatomical change—and that treatment can also. When he gets out, all his professional contacts—journals, medical societies, colleagues, experiences—accentuate his collegiate tendencies. What wonder that he comes to regard the psychoneuroses as having a chemical, physiological or anatomical basis, which is simply too obscure to be as yet discovered? What wonder that he slowly and usually inarticulately realizes that mind and soul also enter into the production of patients?

For this is the first and greatest lesson about the psychoneuroses—that if we get microscopes ten million times more powerful than the ones we now have, we will find no changes in the cells of the body to account for neurasthenia, and if we produce machines a thousand times more delicate than those now in our physiological laboratories we will find no tissue reactions to account for hysteria, and if we perfect chemical tests a hundred times more delicate than those we now possess we will find no toxins to account for personality.

The psychoneuroses, and this must be the cornerstone of their management, are not anatomical, or physiological, or chemical changes. They are not infections, or intoxications, or overstimulations.

What, then, are the psychoneuroses, since these are all the things that they are not? Certainly it will be difficult to put them in a little space—the little space that is at my disposal here. I suppose half the books of the world are filled with some part of what they are. And of an assurance all the books that have been written on them have hardly touched the fringes of the subject. For the subject is "Why man is unsuited to his world."

Since I must be very brief I will begin, not with definition, but with metaphor.

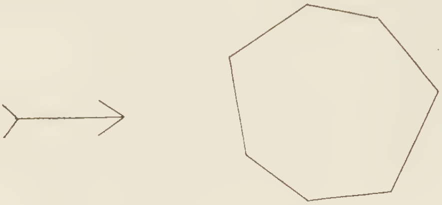
We begin then, as is proper, with a human being born into the world. We will assume, without interruption or argument, that the Declaration of Independence is correct, and that man is, or of a right ought to be,

born with the power to be happy, the power to be successful, the power to be equal, and the power to be free. We will represent this human being as an arrow—thus:

and the arrow is winging onward in full possession of its right to be happy, its right to be successful, its right to be equal, and its right to be free.

It would get all those things if it were the only arrow in the world. But it is not. There is the rest of the world. We might represent the rest of the world as made up of a lot of arrows opposed to this arrow, thus:

But for convenience sake we will represent it thus:



When our arrow strikes the world he finds that the Declaration of Independence is a theoretical document written by a mooney young man who had been reading too much Jean Jacques Rosseau, and that the world is not designed for the reception of free, equal, successful people at all. It is all full of rules, and prohibitions, and competitions, and comparisons, and personalities, and punishments, and fears, and scorns, and just a very little applause, and a few rewards, not nearly enough to go around.

So what happens? Well, partly it depends upon the arrow. So here we must turn our attention from the world and examine the arrow. There are all kinds of arrows, big and little, strong and weak, pliable and brittle, well aimed and poorly aimed, made from good material and from bad material.

When the arrow then meets the world one of several things can happen.

It may be one of those rare strong arrows that goes right through the world tumbling everything aside, overcoming every obstacle until it reaches its goal. (We shall not stop here to get into an argument as to what the goal is or whether there is any such thing.) These strong arrows, or people, seldom consult us on account of a psychoneurosis.

The arrow may be lucky enough to be satisfied with a moderate amount of the things of this world, may be just strong enough to get them, and sensible enough to be contented with so reasonable an adjustment. It settles down in its groove and gives no trouble. Or it may be a blunt, stupid, small-sized arrow that never finds out what it is all about but is so small it finds a place and is satisfied with it. By all odds the largest number of people in this world are typified by this kind of an arrow—the hewers of wood and drawers of water. And they seldom consult the psychotherapist.

It may be that an arrow hits the world and splits into two parts. It then has a disease which the neurologists call hysteria—split personalities. That, at least, is Dr. Janet's definition of hysteria. One personality may be acting like a regular arrow, when all at once the other one throws a fit, goes into opisthotonos, or gets paralyzed, or blind, or deaf, or dumb, or something.

Another arrow may find it is entirely different from all the other arrows in the world and conclude that it is wrong and the others are right, so it crumples up on the world, and either quits trying and gets fatigued, and loses its appetite, and gets dejected, and has melancholia, or else it tries to lay the blame on something, usually itself, and decides it has committed the sin against the Holy Ghost, and that it must propitiate some one, or something, or else it attempts to get like the rest of the world by trying to find the right kind of medicine, or food, or routing out some one who squirts electricity into it, or gets it into harmony, or adjusts its vertebrae, or fits it with glasses, or takes its tonsils out, or straightens its septum, or stitches up its kidney, or dilates the sphincter, or something.

Another arrow discovers it is not like the other arrows in the world, that they are going in the other direction and decides it is the only one that is right, so it gets very excited and begins explaining to the rest of them how wrong they are, and starts reforming them, or stealing from them, or killing them off, or gets so excited it is maniacal. Then if things do not turn out to suit it, it may be exhausted from its efforts and have to lie down a while, or it gets drunk, or takes opium, or goes off with somebody else's wife or husband.

Another arrow may find that it cannot resolve the discrepancies of the world in any way, so it gets it into its head that it is not an arrow at all. Maybe it is a bullet, and being a bullet it gets out of acting like an arrow. So as a bullet it has chronic headache, or dyspepsia, or dragging pains, or neuralgia, or queer feelings generally.

To drop the metaphor, which by this time has become very much strained, what I have been trying to say is that psychoneuroses, and indeed most character perversions and behavior disorders, are due to a

maladjustment between the individual and his world. The lack of adjustment results in what the classical medical psychological literature of our time calls The Conflict. The causes of the conflict are the sum of the different elements in the Individual plus the sum of the different elements in his Experience.

The resolution of the conflict is the person's character—it may be a Psychoneurosis. It should be emphasized that the whole process is so gradual, the initiation of the individual into the stresses of the universe so insiduous that his mind may not acutely focus the elements either of the maladjustment or the conflict, nor of his attempt at resolution of the conflict. He may never, in short, have put it into specific intelligible terms, so that he himself recognizes every step. This is another way of saying what the Freudians stated: that the experiences which initiate the psychoneurosis are thrust into the subconscious.

The illustration which I have used presents an idea of the origin of psychoneuroses which gets away from the Unitarian conception of Freud. Any interaction between the individual and his world may cause a neurosis. The context of it depends upon the individual and his world. It may develop on account of a conflict in the world of sex; Freud said that in his experience sex was the only cause of the conflict; partly because the sexual libido was easily aroused, partly because in the world of human society there was more likelihood that it could not operate unrestrictedly, i.e., without developing antagonisms, social conventions and taboos. That statement is, I think, still true, though Freud's explanations about what are sexual matters broadens the field of sex so that it comprehends nearly everything. But the fundamental concept, and the one that is easiest to understand, and the one which can be preached to the profession and the laity best, is that the psychoneurosis develops as a result of the maladjustment of the individual to his world, no matter what the ground of that maladjustment.

This scheme of mine—this arrow illustration—shows how the conflict may develop all sorts of results. The old rigid classifications do not have to be invoked—classifications which mark out neurasthenia, psychasthenia, hysteria, obsession, phobia, etc. We see above in the possibilities I have named the production either of a forceful dominating personality, or a queer person, or an eccentric, or a crank, or a hypochondriac, or a behavior disorder, or a kleptomaniac, or a criminal, or an excited individual, or an hysteric, or a maniac or a melancholiae, or a dementia precox; so that we can afford to throw overboard all the old rigid classifications and examine the causes and evolution of the development of the psychoneurotic patient. These causes are two, for we are considering the interaction of the individual and his world. We must inquire then

into each of these, remembering that no one single cause operates, in any one case, but a combination of several.

**The Individual.**—1. *Mentally Defectives.*—The individual may have inherited a nervous system actually defective. This defectiveness may range from idiocy at the extreme end, through the degrees of feeble-mindedness, to a nervous system unfitted to cope with the major trauma of life on the other hand.

2. *Weak or Ineffective Physical Makeup.*—The individual may have a body which in some way is a drag. Examples of this are:

a. Visceroptotic type.

b. Chronic universal asthenia.

c. A masked tuberculosis—a tuberculous infection early acquired which remains always sluggish and relatively inactive.

d. Focal infections.

e. Endocrine dyscrasias—thymic individuals—status lymphaticus, pituitary, fat, weak people, cretins, etc.

f. Allergic people, hay fever victims, and food and asthma victims.

g. Congenital syphilis, or early acquired syphilis not producing marked gross signs.

h. Migraine. People having periodical sensory discharges of headache, with gastrointestinal paralysis—sometimes called, especially by the people, "biliousness."

i. Vagotonic or sympathecotonic people.

j. Constipation, or colitis, or mucous colitis.

All of these things are, be it noted, real things. Many people have some of these things as actualities. Sometimes they produce symptoms, sometimes not. For that reason, and also because few of these diseases kill, they are likely to become the rocks upon which some member of our profession founders—anyone of them is likely, in other words, to become some physician's fad. And the patients upon whom it is most likely a physician's fad will be pinned are those with psychoneuroses. I list them here, not because I believe they can be causes of the psychoneuroses, but because individuals who are the victims of one of these disorders may be, on account of the disorder, an inferior individual and, therefore, in a somewhat different relationship to the rest of the world than an individual without any of them.

3. *Personality Differentiation.*—Personality, or individualistic character, differing with every different person on earth, is moulded very largely by environment, or, to be more particular, by the individual's experience in the world. But the inherited mental makeup of the individual also plays a part. Environment and experience are the chisels

which mould personality, but the marble or material out of which it is cut is the inherited nervous system.

One person has a mathematical bent, one a musical, one a literary, one an artistic, and one a bent for accomplishment. There is no question of these tendencies. Half a dozen children are brought up in an orphan asylum, made to lead the same life, and exposed to the same school routine. Some like mathematics and cannot get enough of it; to others it is a bugbear. Yet the same teacher offers them the same incentive or the same repulsion towards it.

**The World.**—1. *Infancy.*—The modern school of psychology states with reason that the most important period of any individual's life is the first six years of it. All the great experiences come freshly at that time. The unconscious but profound observation of parents by the children and the consequent standards—moral and intellectual and physical—that are set up, begins here. If a child is an only child his world is a very different one from the child which is one of six. An oldest child is a different child from a youngest child. He finds his world of companionship, or world of rivalry, growing as he grows. The youngest child finds his world ready made. Whether the parents are happy together or not; whether one parent is dead or inadequate; whether the other children are of the same sex, or opposite, or mixed; whether the older one is a brother or a sister—all these and thousands of other considerations begin to give the human being those experiences which mould his entire future viewpoint.

2. *Childhood and Youth.*—With the awakening of sexual life and knowledge, other motives and reactions begin. They differ in men and women. They may be sentimental, idealistic, carnal or perverted. Whichever they are influences the rest of the life.

There are, however, other motives. I am interested in the thirst for success. It begins in school. I have before me a most important discussion from an article in Mental Hygiene, from which I quote:

"Continued failure is liable to develop an unsocial attitude, or a shut-in personality, to plant the seeds of a mental disorder. As the schools are arranged at present, it often happens that month after month dull children have no opportunity to succeed. It is absolutely essential to give them something to do that is worth while in a situation in which they are likely to meet with success.

"This is true not only because of the psychological importance of success, but because there are definite physiological conditions connected with success and failure. Burnham states that success is sthenic, and probably increases the flow of adrenalin, which acts as a wholesome stimulus to function and a prophylactic to fatigue, toning up the whole system, while failure is inhibitory and depresses function, so that inhi-

bition of the will is likely to result unless one fights against it. Especially in the case of school children, it may depress all the activities.

"Burnham sums up his discussion as follows: 'The need of success as a wholesome stimulus is universal. Children have an enormous appretite for it. They need large doses. It is vital for the normal. The diseased are often cured by it.'

"The extent to which the school, as at present organized, is failing to provide the conditions for successful accomplishment for these children is forcibly shown by the results obtained from questioning 500 factory children who had left school to work. They were asked whether they would prefer to remain in the factory or return to school, in case the family were provided with sufficient money so that their wages would not be needed.

"Four hundred and twelve voted in favor of the factory. The following was typical of the answers given: 'When you works a whole month at school the teacher she gives you a card to take home that says you ain't any good.' "

3. *Adult Experience.*—Choice of a vocation, perhaps even more choice of a fad, marriage or celibacy. Conduct—success or failure—in the vocation, or in marriage, or in the fad, or in celibacy. It would be redundant to attempt to go into detail about these things. There is no novel you can read, no play you can witness, no life story you may hear recounted that, properly interpreted, will not quicken your sensitiveness to their complexes.

**Treatment of the psychoneurosis** then must take into account and weigh all these aspects of the patient, all these aspects of his world. The psychoneurosis is the individual's adjustment to his world. It may be a complete success. You may find the neurosis is the escape, that to rob the patient of the neurosis is to leave him poor indeed. You may find the patient subconsciously regards it as a success—that however much he may protest about it, he does not really want to lose it—whether it be a headache, insomnia, a tendency to go on the drunk, a sense of impending doom, melancholia or whatever. This, in other words, is the familiar fact, that the neurotic often does not want to be cured. For instance, a recurring afternoon headache has saved many a man from going out to evening parties where he is ill at ease. A backache has saved many a woman from doing housework or having a baby, chronic fatigue and constipation have saved many a child from taking the mathematics course, and tantrums has frequently avoided violin lessons, thus perhaps rescuing the world from many a recital. You may find that the neurosis is due to a totally false conception of pathology: thus constipation may not itself be the cause of the ills but what the patient thinks the constipation does to him may be the cause of his ills; in other words, he may *think*

he is being poisoned, and that thought makes him sick. You may find the neurosis is merely imitative: thus a dyspepsia may be due to the daily observation in childhood of an admired parent who could not eat a meal unless the soda were near at hand. The point of attack will differ in all these conditions. In the last two, education combined with some physical measures (see next paragraph) is well adapted to the patient's needs: for instance in the case of constipation, the explanation of the general harmlessness of constipation compared to the harmfulness of chronic cathartic taking, and in the case of dyspepsia imitated from the favorite parent, the unravelling of the origin of the neurosis.

A large number of these patients have the neurosis grounded upon an inefficient physical makeup such as visceroptosis, focal infection, atonic colon, or endocrine dysfunction. I think it is well for the general practitioner or general internist to employ a good measure of physical means along with his psychotherapeutics—abdominal belts and exercises for visceroptosis, baths, massage, diets, sometimes drugs. In those cases which have physical symptoms as the presenting ones—the great quintet being fatigue, insomnia, headaches, constipation and dyspepsia—a combination of psychical and physical measures is, in my experience, productive of the best results. Most neurologists are inclined to employ pure psychotherapy to the rigorous exclusion of all other methods. Theoretically this is correct, but in practice it is too thoroughgoing. The general practitioner or general internist is, in my opinion, the best man to treat these patients, and he is more at home in physical therapy and, therefore, employs it more successfully. On the other hand the general practitioner should employ psychic measures more frequently and learn to have confidence in them, and to believe in their rationale.

Few patients are proper subjects for psychoanalysis. This is one great lesson the neurologists who employ it must learn. They must select their patients and learn restraint about the employment of psycoanalysis. These remarks are the result of experience and reflection. The average psychoneurotic patient has not enough soul stuff to stand the process of psychoanalysis. It confuses most patients, leaves them more shipwrecked than they were before. The psychoanalyst has been more interested in etiology than in therapy. He has gone deeply into the causes of his patient's symptoms under the general impression that he was coincidentally effecting a cure. The result is he dredges up an appalling mass of submerged experiences and tendencies which seem quite innocent to him, but which frighten the patient beyond words. The general practitioner is quite as aware as the psychotherapist that the patient has an unstable nervous system, is not in contact with reality, and that his present state is due to subconscious experiences, but he

thinks it more tactful, more decent and, incidentally, more effective not to know about them: his method of saying—"We'll soon get you out of this"—giving a bread pill, ordering massage, a rest cure and electricity and abstinence from whatever the patient is indulging in has for hundreds of years proved to have the highest proportion of good results and, after a rather involved storm and stress period on the subject, I begin to come around to this way of thinking. The question of names, the eternal interrogations as to what we are giving a patient can be as easily solved by personality as by frankness. "Madame," said William Gull, to a woman who was bothering him for a name for her husband's disease and its treatment, "your husband has a cachexia, and I am administering for him an alterative."

In the field of minor behavior disorders of childhood, I see these two views illustrated rather sharply from time to time with the advantage, to my mind, all on the side of the older method. I do not refer here to the juvenile delinquent; I am speaking of a child of good parentage, in sound economic and social environment who manifests minor traits of disobedience and laziness. Such a child will be taken to a psychoanalyst who will sweat over it, place it in a special school, or give it a trained psychologist tutor or tutoress, in the meanwhile gathering data and observing parents, brothers, sisters, uncles and aunts, and so on, finally announcing that the reason Susie does not do her geography lessons well is because she is jealous of her younger brother Johnnie who was taken on a trip to Port Huron the previous summer. The old honorable, tried, proved way to handle Susie is to spank hell out of her until she learns that the world is full of injustice and that sometimes other people will get to go on trips when she is left behind, and that the important thing for her to do is to shut up and get her geography lesson. The psychoanalyst regards this method as brutal, stupid and incomplete because it does not get to the root of the matter, but the average citizen, including Susie, regards the psychoanalyst's method as a lot of Tomfoolishness, which makes every one uncomfortable and suspicious and generally confused, while its immediate effect on Susie is to focus so much attention on herself that her conceit is practically unbearable. After all, the object of all this is to bring Susie back to proper relations with reality: the spanking does it quite as effectively as the analysis, even though by its method we do not know why Susie lost touch with reality. It must be remembered, too, that smug as the practitioners of psychoanalysis are, their methods have not been scientifically proved: the method has not been in operation long enough for us to learn what kind of adults these little psychologically educated children grow into. While the spanking has been used for thousands of years with only occasional lapses from an unbroken record of success.

The physician after he has made a very complete physical, chemical, radiological, and physiological examination of the psychoneurotic patient must get a very complete record of the entire life history. After doing so, for his own and the patient's guidance and for purposes of treatment, it is well to draw up a graphic chart of the patient's life, showing how much time in that life was devoted to futile disability. This scheme, which I borrowed from Dr. Stanley Cobb, is one of the most effective pieces of psychotherapy I know. I append one of Dr. Cobb's charts and one of my own patient's charts made up on similar lines.

It is also instructive to note what the items in Dr. Cobb's therapy of a given case were:

"1. Wear orthopedic anteroposterior pad to help overcome ptosis and the resulting indigestion.

"2. Put on weight by dieting and put on muscle by abdominal exercise to replace the artificial pad as soon as possible.

"3. Take enough rest so that weight increases.

"4. Take up golf and out-of-door pleasures.

"5. Take mineral oil, cascara, and soda bicarbonate as directed.

"6. Rest completely for two weeks and then get back to work in five weeks.

"7. Remember that the inferiority feeling brought on the desire to overwork, causing the bad hygiene and the resulting symptoms. Try to look on the desire to play the reformer and martyr as a pathologic manifestation of the past poor facing of personal situations. Try to understand people and situations rather than judge them. Thus cultivate a more placid personality."

What is the object of psychic treatment? It is, of course, to induce mental health. What do we mean by mental health? When we talk to modern neuropsychiatrists and hear them explain that a man murdered his wife because he had an infantile mother fixation, and therefore should be forgiven, or that a man gets drunk and neglects his business for perfectly natural reasons of an inferiority feeling sort, and therefore no one should speak harshly to him, all standards seem to disappear. Is there no such thing as right and wrong? Is there no such thing as a normal sane mind? It seems a very complex thing to try to define. Every human being has a different mental life. How can we bring order out of chaos? Various attempts have been made. The following items are put down as rules of mental hygiene by the Pacific Coast Journal of Nursing:

"1. Acquire the habit of emotional self-control. Conscious suppression is a source of strength.

LIFE CHART.

| AGE | SYMPTOMS, ETC. | INCAPACITY. (in black.) | PERSONAL. Father-farmer and saw mill worker, easy going. Mother-strict disciplinarian, agressive, capable. Family history negative. | DATE |
|---|---|---|---|---|
| 1 | | | Born in Conn. on farm | 1878 |
| 2 | | | | 79 |
| 3 | Whooping cough | | Sister born. | 1880 |
| 4 | | | Mother frequently has "stomach and liver trouble." | 81 |
| 5 | Scarlet fever | | Obeyed mother completely, never asserted herself. | 82 |
| 6 | | | Father always bothered with lame back. | 83 |
| 7 | Chicken pox | | Sister born. | 84 |
| 8 | | | Began school. | 85 |
| 9 | | | | 86 |
| 10 | Stomach trouble, began taking medicine. | | Moved to New Hampshire | 87 |
| 11 | Fell from swing, in bed one day. | | | 88 |
| 12 | Measles | | | 89 |
| 13 | Stomach trouble increases | | | 1890 |
| 14 | Menstruation begins. Menorrhagia. | | Left school because of ill health. | 91 |
| 15 | Medecines for "female weakness." | | Occupied with sewing and fancy work. | 92 |
| 16 | Dysmenorrhoea with headache and vomiting. | | Watched by mother and invalidized. | 93 |
| 17 | Headache and vomiting increase. | | | 94 |
| 18 | Retroversion treated with tampons, etc. | | Light housework. | 95 |
| 19 | Leucorrhoea | | | 96 |
| 20 | | | | 97 |
| 21 | "Curvature of spine discovered." Plaster jackets for 9 months. | | | 98 |
| 22 | Grippe. | | Stopped all housework. | 99 |
| 23 | Insomnia and tremor of whole body. | | | 1900 |
| 24 | Broncho-pneumonia. | | | 01 |
| 25 | | | Younger sister married. | 02 |
| 26 | | | | 03 |
| 27 | Exhaustion, smothering spells and palpitation, in bed 3 months. | | | 04 |
| 28 | | | | 05 |
| 29 | New curvature and plaster jacket. | | | 06 |
| 30 | | | Older brother married. | 07 |
| 31 | In bed 6 months. | | Younger sister married. Alone at home with mother and father. | 08 |
| 32 | Tubes, ovaries and appendix removed causing menopause. | | Inspired to write songs. In county hospital. | 09 |
| 33 | Furunculosis. Headaches and vomiting | | | 1910 |
| 34 | Become continuous instead of with menses. | | No work but composing songs. | 11 |
| 35 | " | | | 12 |
| 36 | " | | | 13 |
| 37 | Worse "Boils." | | | 14 |
| 38 | Drawing pains across abdomen and hips. | | | 15 |
| 39 | Exhaustion, can only stand 3 minutes. Stiff neck. | | | 16 |
| 40 | Stiff knees and back. Weight 120. | | Plans to sell songs. | 17 |
| 41 | Fell down, in bed ever since. Leucorrhoea and backache ever since. | | In county hospital. Nursed by mother. | 18 |
| 42 | Dysuria, urgency and loss of control. Gas on stomach. | | In county hospital M.G.H. | 19 |

Life chart as designed by Dr. Stanley Cobb, *The Medical Clinics of North America*, January, 1920, iii, No. 4.

"2. Harden yourself to endure slights, criticism, prejudice, dislike, even abuse. This psychic hardening is highly important if the mind is to keep unwounded and healthy.

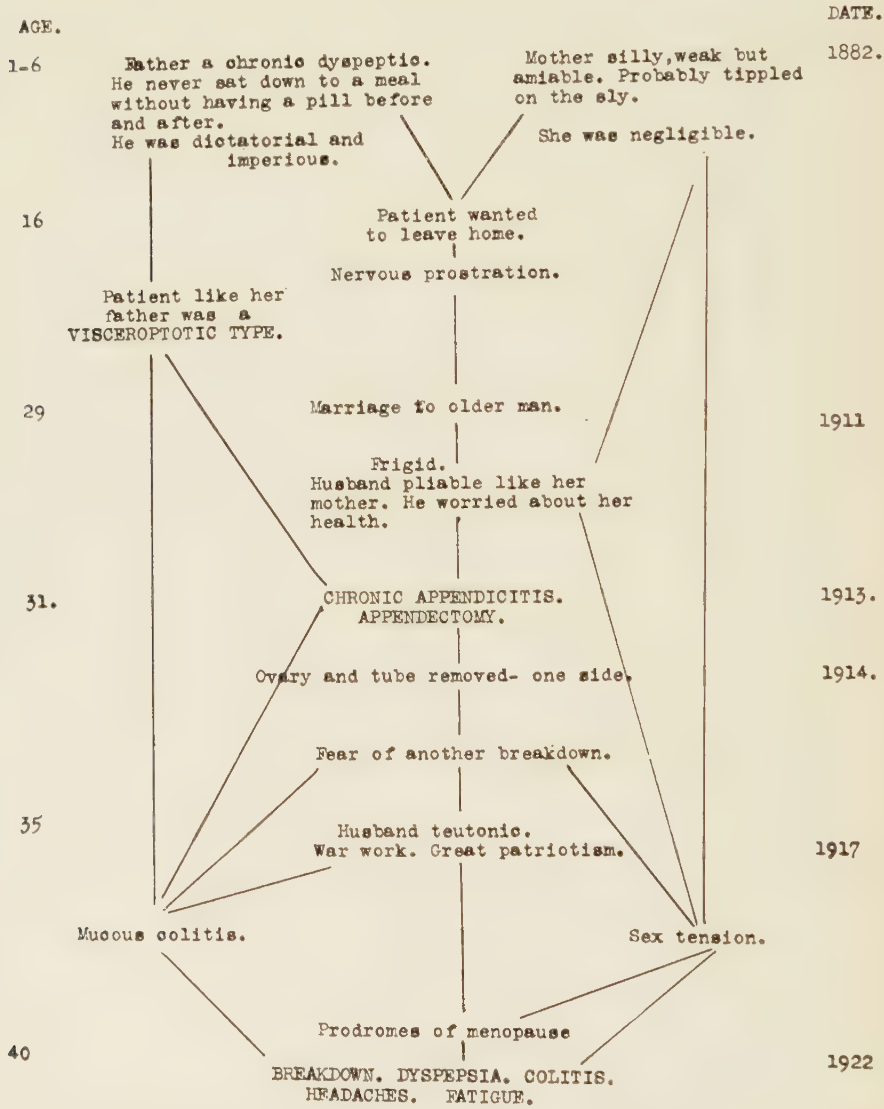



Chart of a patient which attempts to show graphically the causes of her general breakdown in health.

"3. Improve the senses. Exercise them, learn to see, hear, taste, smell and touch more accurately. Exercise the senses deliberately every day.

"4. Put aside unhealthy images and ideas. Don't fight them particularly, but turn your attention to something interesting and healthful.

"5. Increase the accuracy of your thinking. Exercise the mind while at work and play: the good mind is both firm and swift.

"6. Control your attention; always attend wholly to the matter at hand. Your capacity will increase by this exercise. Never let attention dwell on the useless or painful.

"7. Study your normal positions and movements and adopt them consciously when standing or sitting. Your natural attitudes are the best for you.

"8. Learn to practice. If you find a thing hard to do, but desirable, figure out exercises. Your capacity will rise along the well-known 'Practice Curve.'

"9. Learn to relax. Muscular relaxation removes fatigue, both physical and mental.

"10. Imitate good models. Realize that you are bound to imitate in almost every act of life; then surround yourself with people you want to resemble in given qualities, and keep away from others.

"11. Increase your physical and mental lightness. We walk too heavily, think too heavily, play too heavily.

"12. Establish health motivation principles. Don't be impelled by hatred, jealousy and so on, as many people are, even when they do good things. 'The unhappy are always wrong.'

"13. Establish normal relations with other people—normal morally and socially. City dwellers often live in an abnormal world. Many people hardly touch the world at all.

"14. Establish a healthy philosophy of living, having a good goal. You may change it occasionally, but be sure of what you want to accomplish today, tomorrow, next month and in ten years."

All this is somewhat complex and at times vague. "Establish a healthy philosophy of living," for instance, is easy to say but not very concrete. It is possible, however, I believe, to put the matter simply and comprehensively.

*The object of mental hygiene is to cultivate a sane man. That man is sane when he has become real.*

To establish relations with reality—that is our goal, our salvation, our way of life. What does it mean? It means that the individual examines his world and sees his place in it, understands its relations to him, his relations to it. He finds just how important he is in it, and neither exaggerates nor underrates that importance. He finds that he attains importance not by existing, but by work, accomplishment and creation. He learns "to labor and to wait." To wait means that he realizes his desires mature by labor and in time—there is no sudden spontaneous crystallization of what he wants. Of neither knowledge, wealth, nor love, is sudden mastery possible. He learns the importance of other people—

that he must struggle against them to attain his objects, and he learns that this struggle, however uncomfortable it may be in the process, is the best life has to offer him. He learns that in the personal relation with other men and women the great qualities of loyalty, truth, and honesty are the only ones which give permanent satisfaction.

The opposite of a real person is a false person. That is what we must strive to avoid—to know false things, to think falsely, to speak falsely, to act falsely. To be false to himself, to be false to others—think over every hysteric you ever knew, he or she was one or the other or both of those things. And every drunkard, and every pathologic liar, and every thief, and every delinquent, juvenile or adult! The constipated invalid who believes he is poisoning himself—he knows a false pathology and thinks a false doctrine. In the world of ethical experience, the same principle works out. For instance, an individual may be tempted into adultery. After this experience he may regard it in two wrong ways: he may exalt his single example into the idea that it should be a universal rule; like a modernist poet, or a believer in companionate marriage; he may announce that free-love is the proper procedure—in other words, he may justify his unorthodox experience by canonization. On the other hand, he may regard himself as the most disloyal and blackest of sinners—he may come to believe he has committed the sin against the Holy Ghost—he may wallow in the slough of remorse. Neither of these attitudes is sane. Neither of them belongs to the world of reality. The sound attitude seems to me to be to recognize that sometimes desire, temptation and opportunity make an adultery practically inevitable, but the experience is neither to be converted into a rule of conduct, nor into an oppressive burden of regret. From it one may learn something about the strength of that force which Schopenhauer dubbed the "Will to Live," something of one's own pitiful weakness, something of the qualities of another human being. It must be regarded as a natural event, the result of natural laws, but which if glorified into a rule of conduct would wreck the social fabric as well as ruin the soul stuff of the actors because it would negate loyalty, purposefulness, and determination.

The serene example of Goethe is the standard of all our measurements. Beyond any other man of whom we have record, Goethe became the most complete, most utterly sane, most entirely real. He looked back at the end of his life over all that long record of suffering, sin, creation, sensation, and triumph with the calm judgment that he had become, not like any other man, but like all other men. From each experience he had learned and grown; from none, at the end, could that essence which was himself ever be divorced.

"Es irrt der Mensch so lang er strebt."

## References

### *Headaches*

Craig: Headache—Syphilis as the Cause, Am. Jour. Syph., April, 1927, xi, No. 2.
Diamond: Liver Dysfunction in Migraine, Am. Jour. Med. Sci., November, 1927, clxxiv, No. 5.
Hartsock: Migraine, Jour. Am. Med. Assn., October 29, 1927, lxxxix, No. 18.
Miller and Raulston: Treatment of Migraine with Peptone, Jour. Am. Med. Assn., June 30, 1923, lxxx, No. 26.
Vaughn: Allergic Migraine, Jour. Am. Med. Assn., April 30, 1927, lxxxviii, No. 18.
Weed and McKibben: Pressure Changes in the Cerebrospinal Fluids, Am. Jour. Physiol., May, 1919, xlviii.

### *Sciatica*

Hertzler: The Nature and Treatment of Sciatica, Am. Jour. Surg., New Series, October, 1926, i, No. 4.

### *Epilepsy*

Borelli and Girardi: Zentralbl. biochem. Bioch., 1915, xviii.
Geyelin: Fasting as a Method of Treating Epilepsy, Med. Rec., 1921, xcix.
Miller: Evidence that Idiopathic Epilepsy is a Sensitization Disease, Am. Jour. Med. Sci., November, 1924, clxviii, No. 5.
Peterman: The Ketogenic Diet in Epilepsy, Jour. Am. Med. Assn., June 27, 1925, lxxxiv, No. 20.
Wuth: Rational Bromide Treatment, Jour. Am. Med. Assn., June 25, 1927, lxxxviii, No. 26.

### *Neurosyphilis*

Fordyce: Brit. Jour. Dermat., February, 1924, xxxvi, 47.
Stokes and Shaffer: Results in Neurosyphilis, Jour. Am. Med. Assn., Dec. 6, 1924, lxxxiii, No. 23.
Moore: The Treatment of Central Nervous Syphilis, Jour. Am. Med. Assn., Aug. 20, 1927, lxxxix, No. 8.

# INDEX

## I

## U